POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

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DETROIT

Furnace Wall Tube Corrosion

Sherman Creek Topping Program—Part 2

Lignite Awaits Utilization

Short Circuit Protection for L.V. Motors

Distributing Power the Nebraska Way

OCTOBER
1943

SYMBOLIC OF
THE TRADE MARKS OF
INDUSTRIAL AMERICA,
the monogram of Elliott Company typifies the engineering skill and productive capacity which is casting the shadow of defeat over Axis aspirations.
ONE OF AMERICA'S GREAT BUILDERS

e total eclipse approaches

The war is now feeling the weight of one irresistible factor—the combined might of American manufacturers, whose thousands of production lines are disgorging the implements of mechanized battle in a volume almost unbelievable. *The trade marks of America are on the march.*

Every one of these thousands of trade marks represents a standard and type of engineering ingenuity peculiarly American, applied with an understanding of volume production and its possibilities far beyond that of any other people on earth. Each of them is the proud mark of successful individual enterprise, which here in America has come to its fullest fruition. *The trade marks of America are in the fight.*

The Axis powers do not know Production as we know it, nor did they realize the potentialities of American industrial organizations. Else they would not have chosen to start a mechanized war against, of all people, the nation which first introduced volume manufacturing, and whose mechanical ingenuity is supreme. The Axis lost the war at Pearl Harbor, unleashing for their own ultimate destruction the mighty forces of American individual enterprise. *The trade marks of America spell doom for the Axis.*

We believe the unified might of American management, American engineering, American labor, and notably of American individual enterprise, provides the most powerful single factor in the favorable course of the war, and that history will so record it. *The trade marks of America are winning the war.*

Elliott Company is one of those large manufacturing organizations whose products are of a basic type, equally vital and necessary in peace as in war. Elliott power equipment and Elliott process apparatus are today battling toward victory ashore and afloat, just as they will be working to produce the essentials of the greatly expanded scheme of living which will follow the day of victory.

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FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • SUPERCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

ARMY (E) NAVY
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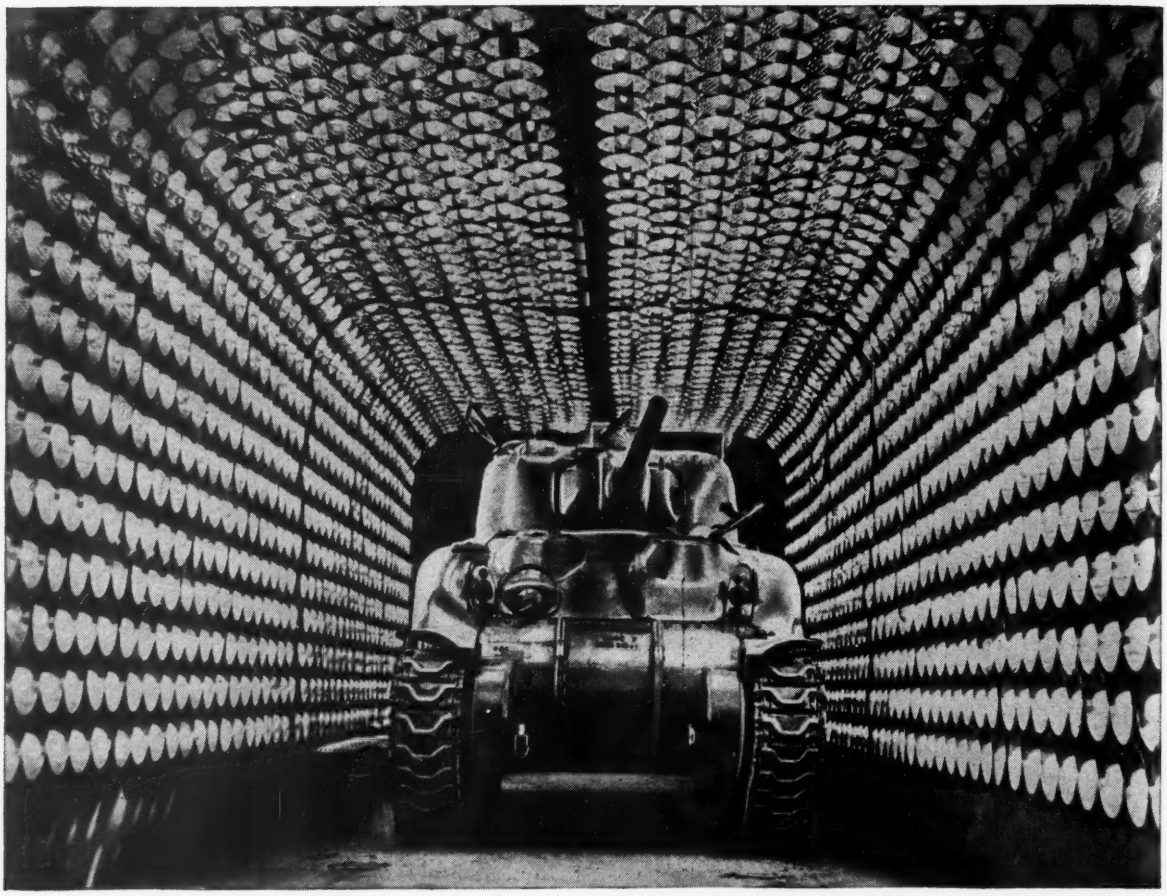
POWER AND PROCESS EQUIPMENT



BEATING NATURE 1440 TO 4

INFRA-RED rays from this tunnel of lamps complete an ordinarily 24-hr. paint drying job in 4 minutes... so fast that drivers of freshly-painted tanks stay at the controls. This new method of quick-drying is a vitally important wartime use of electric light and power.

Furnishing America's ever-increasing needs for electric light and power requires peak output from turbo-generating equipment... and power plants everywhere are getting maximum efficiency from their steam turbines, by lubricating them with *Texaco Regal Oils.*

Texaco Regal Oils assure normal bearing temperatures, governors instantly responsive to every load change. They keep turbine lubrication systems clean, rapidly free themselves from air and water, highly resist emulsification, gum formation, sludging. *They are rust and oxidation inhibited.*

So effective have Texaco lubricants proved that they are definitely preferred in the various fields listed in the panel.

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☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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★More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

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★More buses, more bus lines and more bus-miles are lubricated and fueled with Texaco than with any other brand.

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TEXACO Regal Oils

FOR ALL TURBINES

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

POWER PLANT ENGINEERING

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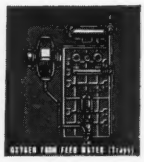
COCHRANE EQUIPMENT FOR THE *Degasification* OF WATER



Cochrane equipment for the degasification of water comprises many types and includes the widest range of sizes and capacities. For the removal of OXYGEN and CARBON DIOXIDE, from boiler feed two types of equipment are available: the tray type Deaerator and the atomizing type. For the removal of OXYGEN FROM COLD WATER, a Cold Water Deaerator of the tray type, operating under vacuum is available. For the removal of CARBON DIOXIDE from cold water, Cochrane supplies a Decarbonater constructed of wood throughout, including wood trays as well as the wood tank. A blower forces air in the bottom of the Decarbonater, which air is vented from the top, scrubbing the water and carrying the carbon dioxide with it. For the removal of HYDROGEN SULPHIDE, an apparatus similar to the Decarbonater is used except that the design takes into account the higher solubility and provides means of controlling pH value. For the removal of AMMONIA, Cochrane furnishes an Ammonia Degasifier, comprising a tray stack of unusual height and utilizing a quantity of steam far in excess of that which can be condensed by the water under treatment.

The above illustrates the range and comprehensiveness of Cochrane equipment for the degasification of water. But Cochrane engineering service does not stop with these designs. Special equipment may be necessary for your own particular problem. We shall be glad to answer your questions.

COCHRANE CORPORATION • 3123 N. 17th ST. • PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

FRONT LINES

THE JAPS ordered it, Switzerland manufactured it, Italy shipped it, BUT—Uncle Sam has it and is putting it to work to help lick the Japs—a complete conveyor system for a smelter. During the latter part of 1941, the Gautschi Electro-Fours, Switzerland, manufactured the equipment for a Japanese smelter. It was shipped from Genoa, Italy, to New York, for transshipment to Japan. The Customs Authority of the Port of New York declined to enter the shipment and held it in storage, on instructions from Washington. Engineers determined that the equipment was of peculiar design and could be used by only certain types of furnaces. Even after the puzzle of the assortment of boxed parts had been solved and the Redistribution Division of WPB had succeeded in obtaining complete specifications from Switzerland, a long search was necessary to find companies that could put the equipment to use. But such plants were found. The final act of the drama was an auction sale held recently at the headquarters of the Customs Authority in New York. When the auctioneer's hammer dropped finally, title to the equipment passed from the Customs Authority to the North American Smelting Co. of Philadelphia, and the equipment was enlisted in U.S. war production.

"GET THERE Fustest with the Mostest!" This is reputed to be the recipe given by General Bedford Forrest, the Confederate general, for winning battles from the Union Army in the Civil War. Its effectiveness has never been disputed. The word mostest includes supplies and these, when they reach the battle fronts, must be in usable condition. Most people have no conception of the physical problems of transporting military supplies across the oceans and by all kinds of land transport in foreign countries. For that reason the methods by which these supplies must be packed so that they will reach their destination in usable condition are of the highest importance in wartime. If you are interested in this, you will find a complete, detailed and extremely authoritative discussion of the entire matter of packing in the July 1943 issue of Exide Ironclad Topics. This is based on material supplied by the U. S. Navy and the illustrations of packaging and packing details are particularly valuable.

NOTE to all post-war planners: 1. Is there any way whereby the main tenet of democracy, which is government with the consent of the governed, can operate in foreign affairs at least to the extent that it does in domestic affairs? It does not so operate now. 2. Is there any way whereby other countries can deal with America with any definiteness and finality? Can they have any assurance that agreements duly arrived at in negotiations with the official representatives of this country will stand? They have no such assurance now. These two questions, says Nathaniel Peffer in the August Harper's, are fundamental to any consideration of America's future relations to the world; all else is subordinate to them or affected by the way in which they are answered or acted upon.

IN 1925, RUSSIA had been through a devastating war and a violent internal revolution. Yet by 1933 Russia had invested sixty billion rubles in factories, new cities, armaments, schools, houses. Where did the money come from? In 1933 Italy was bankrupt, had no credit abroad and almost no gold, yet Italy went ahead and conquered Ethiopia and emerged without financial collapse. Where did the money come from? Hitler took over a German state that was literally bankrupt by every standard of personal, national and international finance. Every school boy knows what he has done with it since that time. Where did the money come from? Long years of war in China had reduced the Japanese economy to a bag of bones. It was completely bankrupt. Yet it opened a new attack with military equipment as excellent as it was unexpected. Where did the money come from? In 1939, the United States Congress declined to appropriate four billion dollars for highways, conservation, hospitals, freight cars, in the bitterly contested lend-spend bill. That, it was held, would lead to national bankruptcy. Yet since the fall of France in 1940, Congress has appropriated almost three hundred billion dollars for armament. Where did the money come from? After the war there will be a towering political demand for a world delivered from chronic depression. Where will the money come from? These questions are discussed and answered in detail by Stuart Chase in a brilliant series of articles beginning in the September 4 issue of The Nation. They are based on a chapter from his forth-coming book to be published by the Twentieth Century Fund, under the title "Where's the Money Coming From? Problems of Post-War Finance."

SALES of liquefied petroleum gases continued to expand strongly in 1942 as in recent years, says the latest Mineral Industry Survey of the Bureau of Mines, U. S. Department of the Interior. However, difficulties connected with the war probably prevented the full supplying of the potential market. Distributors of liquefied petroleum gases reported sales of 585,440,000 gal in 1942, a gain of 27 per cent over 1941 deliveries. Of this total for 1942, the distribution of various products was as follows: Butane, 128,560,000 gal; propane 150,-511,000 gal; butane-propane mixtures, 301,917,000 gal; pentane, 4,452,000 gal.

A MAN, wanting to know whether or not three different coal laboratories could check on the quality of coal in a certain truckload, took three cans, filled each with a scoopful of coal from three different places in the truck and delivered one can to each laboratory. Naturally the results of the analyses varied widely. The reason why this is so, why coal must be sampled and analyzed properly and why it is important are discussed in detail in a very interesting article on Coal Sampling and Analysis by W. D. Langtry of Commercial Testing and Engineering Co. in the June-July issue of The Fusion Point. We recommend it not only to engineers but also to all industrial executives who have anything to do with the purchase of coal for their plants.

KNITTING UP the ravel'd sleave of care is what most of us spend one-third of our lives doing. Translating from the Shakespearian, that means simply sleeping. For a procedure that occupies 33⅓ per cent of our total time, this subject has received practically no attention as a scientific phenomenon until comparatively recent years; it was formerly the domain of the poets only. Some very interesting comments on sleep are given in the September issue of the Industrial Bulletin of Arthur D. Little, Inc. Of course, in any discussion of sleep, we must remember, and so must the scientist, that our present sleeping habits are largely the result of centuries of long tradition, based primarily on the fact that when it got dark people simply had to stop what they were doing and the only thing left was to go to sleep. With the slow development of lighting devices, this traditional habit changed very little, for some reason. The Industrial Bulletin discusses the matter of both amount and quality of sleep and recounts data on shortening sleeping hours, particularly some experiments made on himself by R. Buckminster Fuller, the famous designer of the Dymaxien house and automobile. Other investigators indicate that there is a definite correlation between the feeling of physical well-being and the length of sleep. Dr. Donald A. Laird of Colgate, who conducted research on sleep for a number of years, has data to indicate that persons of importance and distinction do not go without sleep as the poets and writers of maxims would have us believe. On the contrary, he finds that the vast majority of them get a full eight hours sleep every night. Dr. Israel Bram also finds that, of a group of a thousand men and women prominent in all pursuits, 65.5 per cent sleep an average of eight hours a night. A great many people of this generation were brought up in a society that seemed to feel something sacrosanct in the remark of the poet: "The heights by great men reached and kept Were not attained by sudden flight; But they, while their companions slept, Were toiling upward in the night." 'Tain't necessarily so!

A LIBERAL EDUCATION in 15 minutes a day—read the house magazines. Pentagon Building, an Air-Conditioned City, Masonry Saws and Taking Bugs Out of Bombers, an article describing how models of bombers are tested under actual flight conditions, all in the August issue of The Dragon of Fafnir Bearing Co. Clinical Thermometers, a description of exactly how they are made and calibrated, also an article on how boxing gloves are made, Oil-Power, July-August issue, Socony-Vacuum Oil Co., Inc. Salute to Charlotte, an interesting description of one of the South's most important cities, Shell Progress, July-August, Shell Oil Co. Front-Line Printing, a description of one of the Army's mobile reproduction trains; also War-Time Printing at West Point, an important feature in the efficient operation of the Academy, The Linotype News, July-September 1943. Food for Victory, a series of extremely interesting articles, illustrated with some unusual photographs, on plowing and seeding, fertilizer, cultivating and harvesting, the farm home, irrigation, citrus fruits and dairy products, illustrating the use of copper and brass in food production, Copper and Brass Research Association's bulletin, September. Trouble Shooting in Internal Grinding, Evaluating Grinding Compounds, Wheel, Work and Traverse Speeds, Grits and Grinds, July, the Norton Co. The Guerrilla Fighters of Naval Warfare, a fascinating illustrated story of the submarine, Exide News, August. How many $18.75 War Bonds it requires to buy a torpedo bomber or fire a broadside from a battleship and a dozen other items of war equipment, shown in a very simple chart form, Armstrong Trap Magazine, No. 3, 1943. And last, as a gesture to culture with a capital C and humor with a capital H, The Refresher That Pauses, one of Ware Holbrook's funny articles on how and why he decided to learn Greek and shorthand, in The Amsco Bulletin.

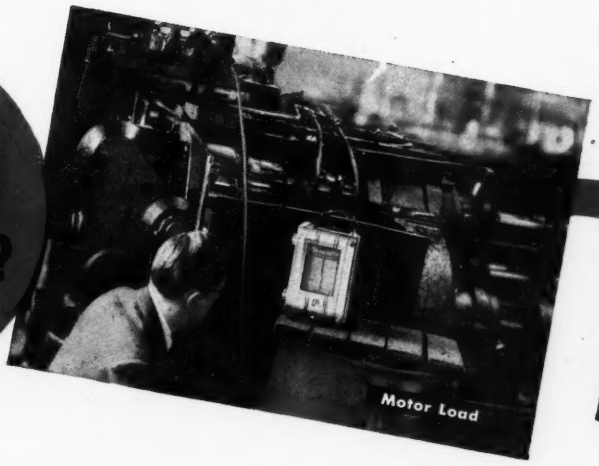
ALL READERS are urged to give full support to the program for conservation of electricity recently begun in a series of newspaper advertisements by the various utility companies throughout the country in cooperation with the Office of War Utilities. Everybody should understand that the object of the program is to reduce the amount of materials, fuel, manpower and transportation required in producing electricity and does not arise from any inability on the part of the industry to produce all the electricity needed. Furthermore, the conservation program does not mean reduction of use of electricity where it will impair vision, reduce safety or affect production adversely. It means only elimination of any electricity use not absolutely essential. If a 10 per cent reduction in domestic and commercial use of electricity could be made, it would save over 4,000,000 tons of coal and more than 75,000,000 lamp bulbs, requiring many man-hours to produce and transport. In the lamp bulbs, tungsten would be saved for badly needed steels and alloys needed for tools and armaments. Your local utility will give you all the details of what can and should be done to conserve electricity.

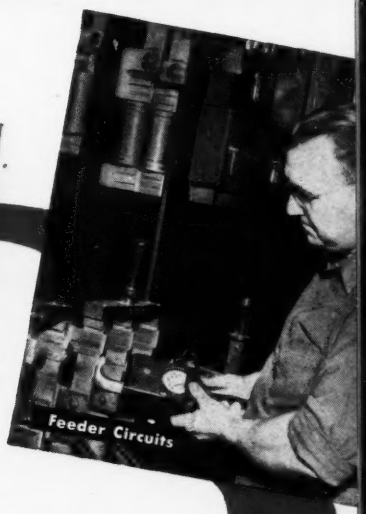
WITH MILLIONS of bushels of grain being stored for reserves against greater needs and growing shortages, the problem of keeping the grain in good condition grows more and more acute. Frequent moving from bin to bin has always been a necessary precaution in the case of some stored grains, due to the dangers of accumulating gases from early stages of fermentation. The possibility of fermentation is itself a loss, but the potential danger of explosion is even more to be avoided. Grain conditioning by circulating air through the bins could easily save millions of bushels and reduce labor needed, according to the Compressed Air Institute. Blowers of the type suited to this grain conditioning service are readily available in sizes up to 4000 cfm capacity and at pressures of approximately 1 psi.

YOU CAN BUY the individual components of any good manufactured article, such as a good radio set or refrigerator, for a comparatively few dollars—or you could before the war. But have you any idea how much you would have to pay for the intangible factors incorporated in that radio set or refrigerator? Those intangible factors include the knowledge of how and why to put the parts together to make them operate in a certain way and how and why to make the parts so they will do that. They include the failures of men as well as their final success. They include, as Charles F. Kettering recently pointed out, those intangibles that cannot be measured in any sense in terms of money: man's ability to think and his dissatisfaction with things as they are.

The RIGHT Instruments Help Get the Jump on TROUBLE

How Would You Handle these 3 Jobs?





1 **MOTOR LOAD** is being analyzed with a G-E portable inkless recorder. The test is made *without interrupting production,* simply by using a split-core current transformer (clamped around a lead in the control cabinet) connected to the recording ammeter.

2 **FEEDER CIRCUITS** are being checked with the G-E hook-on volt-ammeter. Both current and voltage are measured with just *one* instrument, simply by flicking the selector switch, first to AMPS and then to VOLTS.

3 **MOTOR-STARTING CURRENT** is being determined quickly by means of a G-E pointer-stop ammeter. An oscillograph could be used, but it is easier to use this instrument—particularly when there are a large number of motors to be checked.

These are typical examples of using the RIGHT instrument to get electric-circuit information in a hurry, without interrupting production. Have you the RIGHT ones for your preventive maintenance? This is particularly important if you have green hands in your maintenance department.

5 Instruments Will Do 90% of Most Testing Jobs

The G-E instruments shown below will handle most of your testing. Prices are for estimating only. For details, ask the nearest G-E office for the bulletins listed. If you need other instruments, let us know. *General Electric, Schenectady, N. Y.*

WHICH OF THESE TESTING INSTRUMENTS DO YOU LACK?

A-C HOOK-ON VOLT-AMMETER. The handiest of instruments for quick load checks—no cutting conductors or interrupting service. Measures volts also. Bulletin GEA-2950.

MEDIUM-SIZE PORTABLE, A-C (AND DP-9, D-C). Accurate within ¾ of one per cent. Very portable—size only 2½ by 4¾ by 6½ inches. Price covers a 5-amp ammeter. Bulletin GEA-1784.

POCKET-SIZE PORTABLE, A-C (AND DS-5, D-C). Accurate within one per cent. Slips easily into a coat pocket—size 2 by 3½ by 5½ inches. Price covers a 5-amp ammeter. Bulletin GEA-1784.

INKLESS RECORDER, PORTABLE. An inexpensive instrument. Inkless—no pen to start and no ink to spill. Price covers a 5/10-amp ammeter. Bulletin GEA-3187.

INK RECORDER, PORTABLE AND SWITCHBOARD. Ideal for use where a high degree of accuracy is very important. Price covers a 5-amp portable ammeter. Bulletin GEA-1061.

GENERAL ELECTRIC

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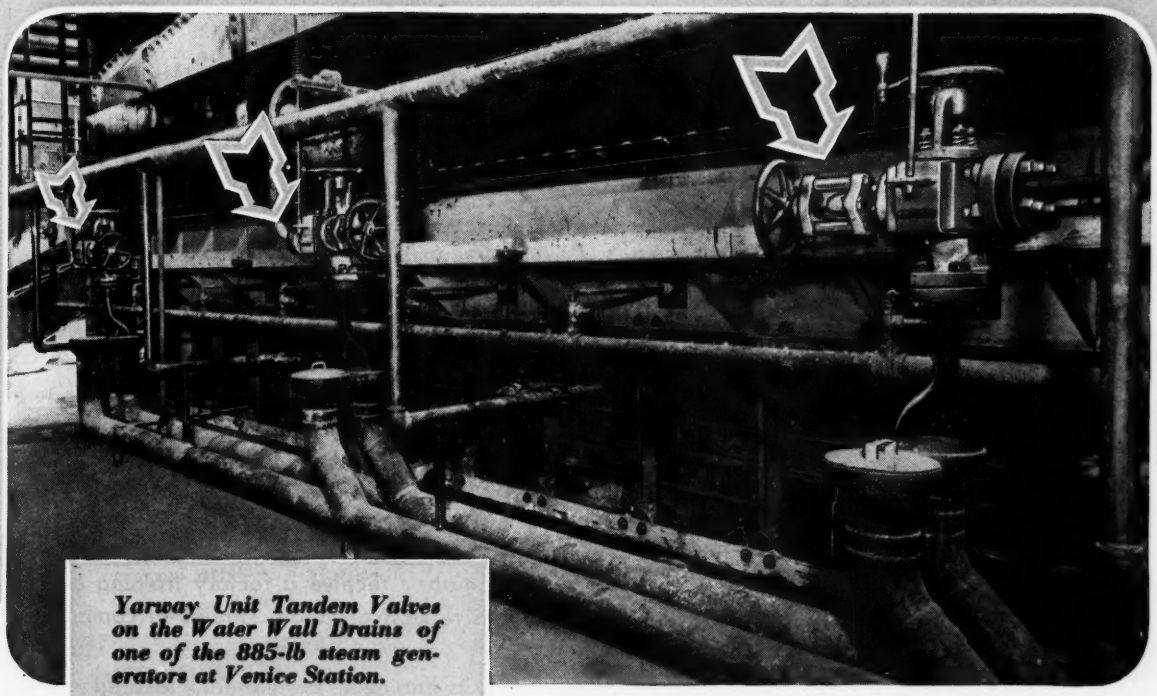
16 YARWAY UNIT TANDEMS..

Typical main boiler blow down Yarway Unit Tandem arrangement at Venice Station.

YARWAY

Selected for Both Blowing and Draining on latest VENICE STATION units



Yarway Unit Tandem Valves on the Water Wall Drains of one of the 885-lb steam generators at Venice Station.

AT the new Venice, Illinois, Station of the Union Electric Company, Yarway Unit Tandem Blow-Off Valves were selected for both main boiler blow-down lines and water wall drains on these latest 885-lb pressure units.

Years of experience with Yarway Valves at the Cahokia Station of this company where 240 Yarway Seatless Valves have been on the job—some as long as 14 years—undoubtedly played a big part in influencing the selection of these Unit Tandems—the finest Yarway Valves ever built for high pressure service—for this modern central station.

What are your drain or blow-down valve requirements? Profit from the sound design and metallurgy of Yarway Valves, proved in more than 12,000 low, medium and high pressure Yarway installations.

Write for Catalog B-422 for pressures up to 400 lb; B-431 for pressures up to 2500 lb.

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114 Mermaid Avenue, Phila. 18, Pa.

BLOW-OFF VALVES

Effective Instrumentation

DEPENDS UPON *Engineering*

Bailey Field Engineers who are specialists in combustion testing and boiler control, carefully adjust each Bailey Boiler Meter and Control System to its boiler unit. This method of application insures maximum effective performance of metering and control equipment.

★ It is relatively easy to construct a ratio meter for the measurement of Steam Flow and Air Flow; but to properly apply it to a steam generating unit requires experienced, competent engineering service. Successful application depends upon skill in making the combustion tests which determine the final setting of the meter.

The Bailey Engineering Organization, which includes graduates from over 40 different Engineering Schools, has grown up with the modern boiler plant. Over 25 years ago, when units were small and crude compared to those available today, Bailey Engineers served the industry by conducting combustion tests and adjusting Bailey Boiler Meters to guide the way to maximum combustion economy. Since then, boilers and furnaces have seen many improvements and Bailey Engineers have been constantly in close contact with their development. This experience has yielded a store of "know how" which is now drawn on by Bailey Engineers in their work of adjusting metering and control equipment for optimum results. All graduate Engineers entering the employ of Bailey Meter Company receive a factory training course which includes comprehensive post graduate studies in combustion and boiler control.

Bailey Meter Company has its Engineers permanently located in over 30 cities throughout the United States and Canada. These Engineers concentrate exclusively on the application and adjustment of Bailey Meters and Control Systems. Their activities are directed by Bailey branch office managers who are well qualified Combustion Engineers of long experience. Most of these managers have been associated with the Company for over twenty years.

Through this seasoned field engineering organization, Bailey Meter Company offers Power Engineers a safe, sure way to maximum boiler steaming capacity, fuel economy, conservation of man power, and minimum outage of equipment.

For an outline of the many ways in which Bailey Meters and Control Systems serve the modern steam plant, ask for a copy of Bulletin No. 15-B.

BAILEY METER COMPANY

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The Complete Combustion Control System

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ONE OF A SERIES OF ISUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE
Operating Problems with Correct Lubrication
1 TO PREVENT RING STICKING, A FILM OF OIL MUST BE MAINTAINED BETWEEN THE RINGS AND THEIR GROOVES
2 TO MINIMIZE RING AND LINER WEAR, A TOUGH OIL FILM MUST BE MAINTAINED BETWEEN THE RINGS AND CYLINDER WALLS

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

Get 2 Jobs Well Done

AS YOU SEE ABOVE, an oil film must be maintained in a Diesel (1) between the rings and their grooves, and (2) between the face of the rings and the cylinder wall. At these places the oil film is subjected to heat, pressure and oxygen. Inferior oil will oxidize, cook and form hard carbon deposits.

These deposits will cause ring sticking that results in costly wear, power-wasting "blow-by"!

Gargoyle D.T.E. Oil Nos. 1-to-5 give maximum protection against deposits — both on pistons and rings. They have been specifically designed to meet the *severest* requirements of the intermediate and large size engines built and operated today.

GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC. — Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp.

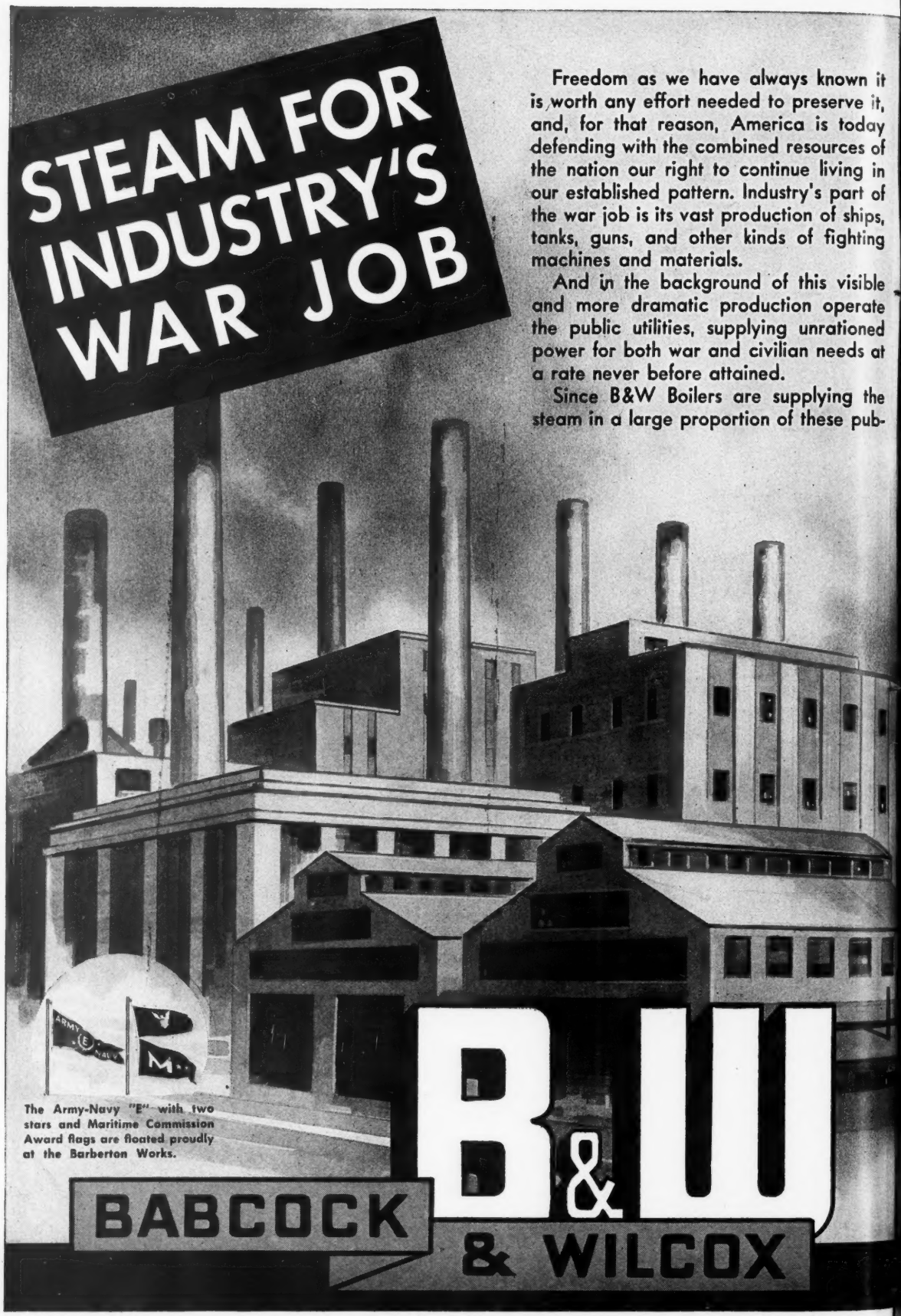
CALL IN SOCONY-VACUUM

STEAM FOR INDUSTRY'S WAR JOB

Freedom as we have always known it is worth any effort needed to preserve it, and, for that reason, America is today defending with the combined resources of the nation our right to continue living in our established pattern. Industry's part of the war job is its vast production of ships, tanks, guns, and other kinds of fighting machines and materials.

And in the background of this visible and more dramatic production operate the public utilities, supplying unrationed power for both war and civilian needs at a rate never before attained.

Since B&W Boilers are supplying the steam in a large proportion of these pub-



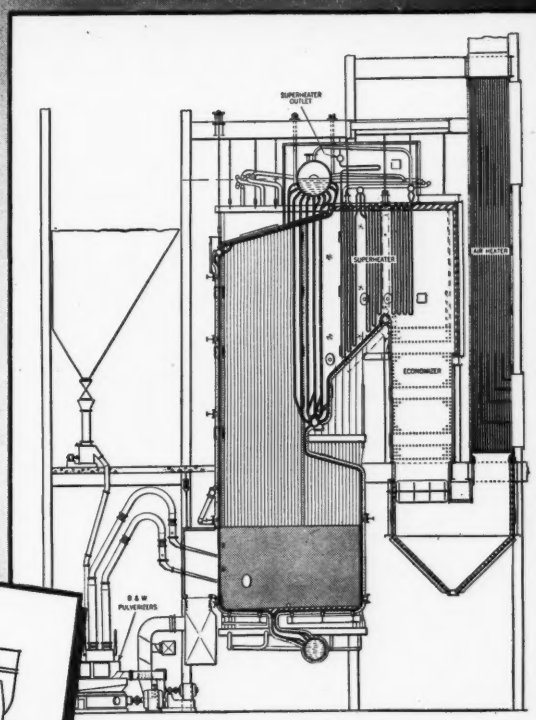
The Army-Navy "E" with two stars and Maritime Commission Award flags are floated proudly at the Barberton Works.

BABCOCK & WILCOX

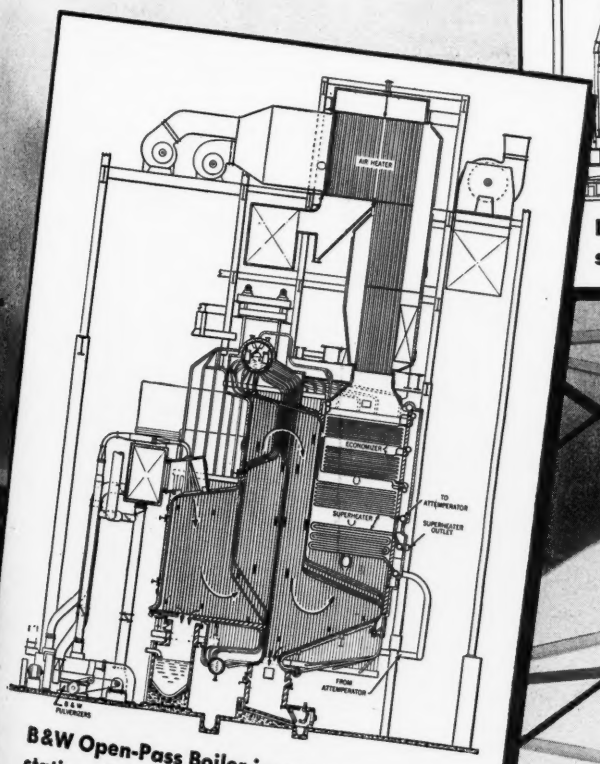
B&W

lic utility and industrial power plants, and for propelling naval and cargo ships, B&W is playing a substantial part in this great war effort. B&W engineering and production skill have built into its boilers the stamina to endure today's gruelling drive.

With today's accelerated experience yielding more complete answers to such problems as behavior of metals at high temperatures, action of fuels in slag-tap and dry-ash furnaces, circulation in high-capacity high-pressure boilers, separation of steam from water in boiler steam drums, and other related problems, the boilers of tomorrow should be even better able to serve industry.



B&W Radiant Boiler in an eastern central station—Capacity 400,000 lb. steam per hr.



B&W Open-Pass Boiler in an eastern central station—Capacity 350,000 lb. steam per hr.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK 6, N. Y. G-254

Armstrong traps make

56.25% LESS BOILER CAPACITY NEEDED

The Midland Chemical Company, Dubuque, Iowa, had placed an order for a new 125 H.P. boiler, but found that the recommendations of an *Armstrong Trap Representative* for a new return system and Armstrong Trapping so increased efficiency they were able to change the order to an 80 H.P. boiler instead!

Fuel oil consumption was cut from 1,500 down to 700 gallons a week.

The boiler room did not have to be enlarged as would have otherwise been necessary.

Faster heating and higher, more uniform temperatures were secured on process equipment.

IT'S A GOOD HABIT TO CALL IN AN ARMSTRONG TRAP MAN IF YOUR PROBLEM HAS TO DO WITH STEAM.

ARMSTRONG *Inverted Bucket*

Boilers Bigger!

When Armstrong Traps replace inefficient drainage devices or old, obsolete traps, the resulting steam saving usually is equivalent to a sizeable increase in boiler capacity. Any engineer naturally will question just how this steam saving is accomplished. The answer is simple.

STEAM TIGHT VALVES. Armstrong valve parts remain steam tight for a long time. This is due to such design and construction features as:

1. Valves and seats are water-sealed at all times.
2. Valves and seats are made of chrome steel. The parts are heat treated after machining. The ball valves are precision ground. Valves and seats are lapped together. Fussy operations, but they pay in steam savings.
3. Free floating lever design lifts valve to seat without leverage, thereby minimizing wear.

AUTOMATIC AIR ELIMINATION. This saves steam in several ways:

1. No manual blowdown necessary to rid pipe or steam heated unit of air.
2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

SELF-SCRUBBING ACTION. This saves steam because:

1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

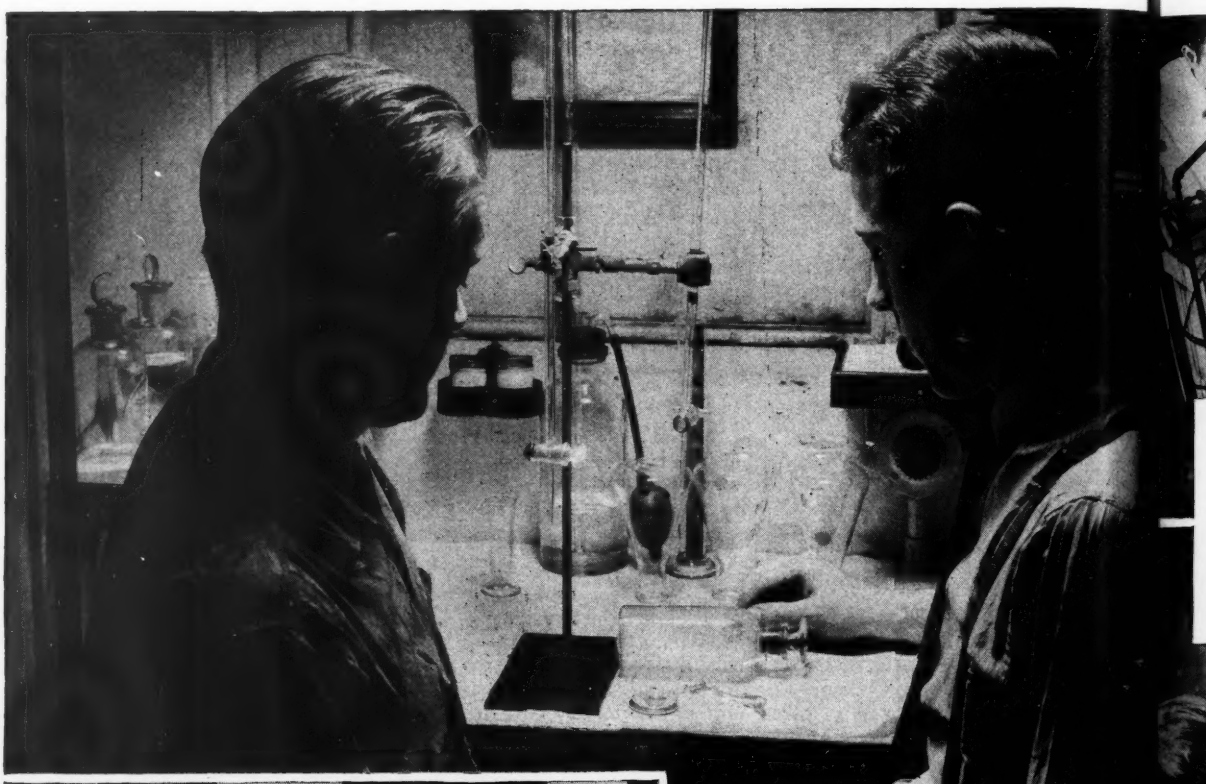
Armstrong originated the inverted bucket trap in 1911. For more than thirty years, the Armstrong Machine Works has specialized on making inverted steam traps. During this same period, Armstrong Representatives have specialized on mastering trap selection and installation problems. Call your Armstrong Representative the next time a trap problem rears its ugly head.

ARMSTRONG MACHINE WORKS
810 Maple St. • Three Rivers, Mich.

HEY, MAN! DON'T DO THAT!
SILLY, ISN'T IT?
BUT IT'S JUST AS SILLY TO HAVE TRAPS THAT DON'T REMOVE AIR FROM STEAM SPACES, OR NO TRAPS AT ALL

STEAM TRAPS

A BOILER WATER SERVICE

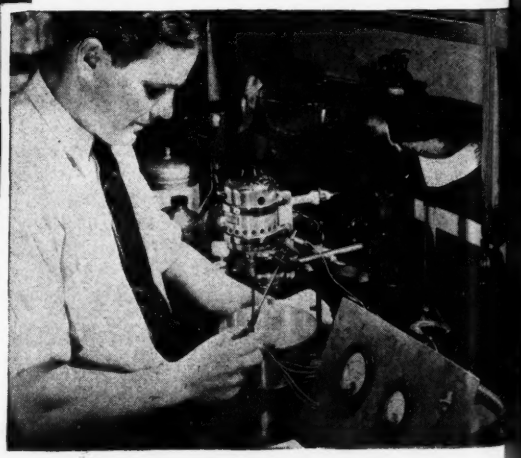


1. FIRST-HAND INFORMATION obtained by the Hall Field Service Engineer is the primary step in *preventive care* of boilers. The Hall Engineer instructs your power plant operator in how to make daily boiler water tests. These tests give Hall Laboratories intimate knowledge of what's going on in your boilers.

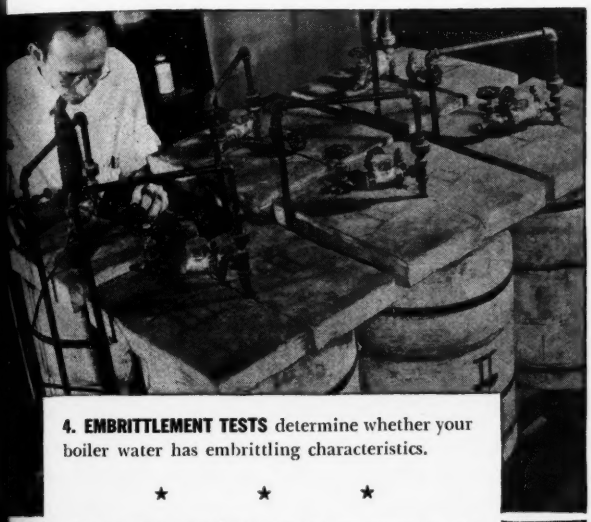
2. PREVENTIVE CARE IN ACTION. Hall Laboratories' careful periodic analysis of boiler water from your plant, coupled with simplified control analyses by the plant personnel, assure proper boiler water conditions to keep your plant in steady operation year after year.

★ ★ ★

3. SOLVING THE TOUGH PROBLEMS. Metallurgical analysis of a split boiler tube is indispensable in determining the underlying cause of the trouble.



not MEASURED IN SALES



4. EMBRITTLEMENT TESTS determine whether your boiler water has embrittling characteristics.

★ ★ ★

5. PROTECTION ASSURED for boilers operating at highest temperatures and pressures. This steel bomb duplicates conditions far beyond the critical point of steam temperature.

Why Hall Field Engineers are *salaried* specialists

THE Hall engineer assigned to you has only one aim—to help you keep your boilers in prime condition. An unscheduled outage caused by water in his territory is one of the worst things that can happen to him—because he is paid to help prevent it from happening. The Hall engineer uses all of the tools of his trade, but he derives no commissions from any chemical or equipment he prescribes.

It takes years to make a Hall Field Engineer . . . years going to school to the men who pioneered in boiler water conditioning and who are today's acknowledged leaders in this field.

The need is plain. A Hall Field Engineer shares the responsibility for millions of dollars worth of critical equipment. He can't carry on that job the way we mean he should if he has any commercial interest. His own success, and that of the Laboratories, rests solely upon his ably answering the challenge.

Unique? Perhaps. But to ourselves and to the hundreds of important plants we have served for years, it makes pretty good sense. May we tell you more about it?

HALL LABORATORIES, INC.
A subsidiary of Hagan Corporation
HAGAN BUILDING, PITTSBURGH, PA.

Hall Service in a Nutshell

... your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.

HALL SYSTEM *of Boiler Water Conditioning*

HAGAN
HALL
BUROMIN
CALGON

TAYLOR STOKERS Keep Steady Pressure on Dancing Steam Flow

YOU'VE SEEN enough of these steam flow charts to recognize this one—from another famous war plant—as a steam hammer load. But while the flow pen jiggles all over the chart, the pressure pen holds a strong, firm course.

The charts were taken from recorders on the latest of six Taylor Stokers (installed last year) in a metal-working plant—a six Retort stoker under a 628 H. P. boiler, burning high volatile coal and operating at an efficiency of 78 to 80% without any heat recovery equipment.

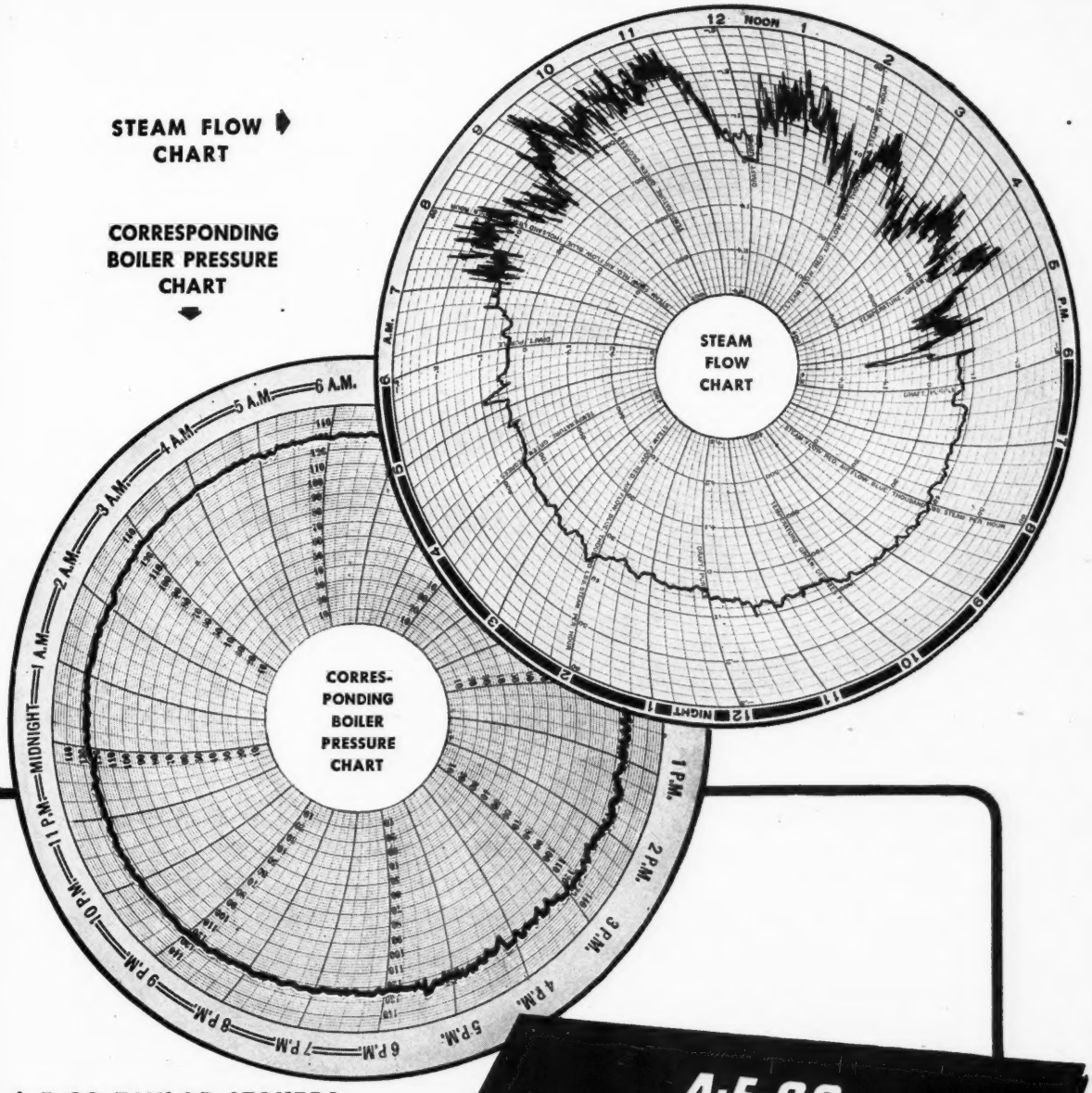
Once again Taylor Stokers demonstrate their ability to operate efficiently, and maintain even pressure on severely varying loads.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



A-E-CO TAYLOR STOKERS
LO-HED HOISTS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

A-E-CO TAYLOR STOKER

COMPANY

AE CO 75th ANNIVERSARY

A LESSON IN WATER COOLING

LESSON 7 OF A SERIES

INDUCED DRAFT COOLING TOWERS OF HORIZONTAL DESIGN

Any product which consistently leads its field is generally the one which offers the most practical combination of all desirable features at least cost. In the case of mechanical apparatus, careful *designing* is necessary to coordinate the theoretical with the physical factors; and *users' experience* will invariably point out the design which does this best. Note the greater use of *horizontal* steam condensers. Also note the success of heaters, coolers, boilers and other heat-transfer apparatus that employ the cross-flow principle.

The horizontal type cooling tower employing horizontal air-flow is another example. It has won and held first place in its field through the past five years due to the simplicity and soundness of its basic design plus the general excellence of its physical characteristics.

Increasing the efficiency of evaporative water cooling equipment is a matter of accelerating the effective rate of heat transfer. Observe how the design of a horizontal type cooling tower accomplishes this by means of *perfected air-water flow.*

AIR FLOW

AIR VELOCITY: The uniform construction, both horizontally and vertically, of the air inlet louvers, the internal filling and the drift eliminators permits an even, straight-line air flow of uniform velocity for the *full travel* through the cooling chamber.

The fan suction chamber and drift eliminator design make possible the complete, equalized control of air velocity over the entire breadth and height of the cooling chamber.

AIR QUANTITIES: Greater air quantities with least draft loss are possible in horizontal cooling towers since the design permits (a) large and ample air passage through inlet louvers (b) large and ample air passage through the filling (c) large and ample air passage through drift eliminators (d) elimination of obstructions to air flow, such as internal systems for water distribution and baffles and filling laths set broadside to the air flow, and (e) elimination of air turbulence in general.

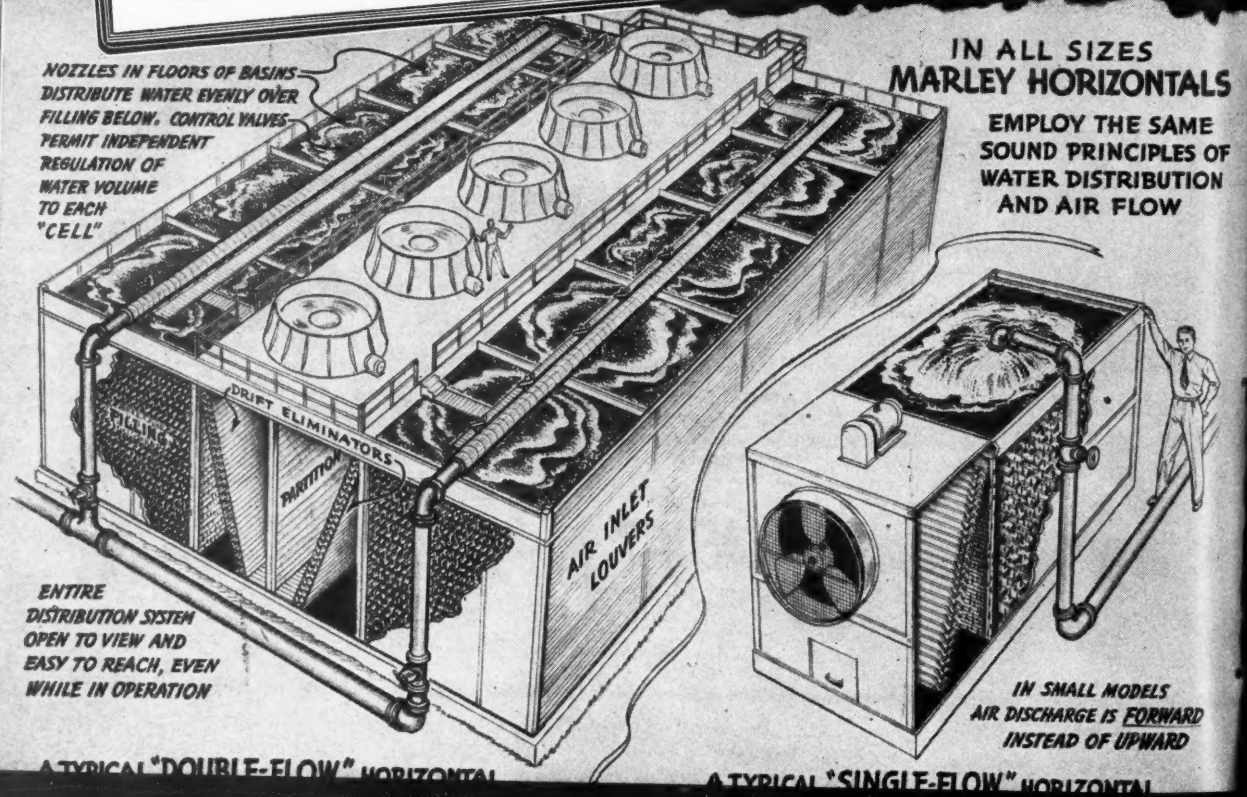
WATER FLOW

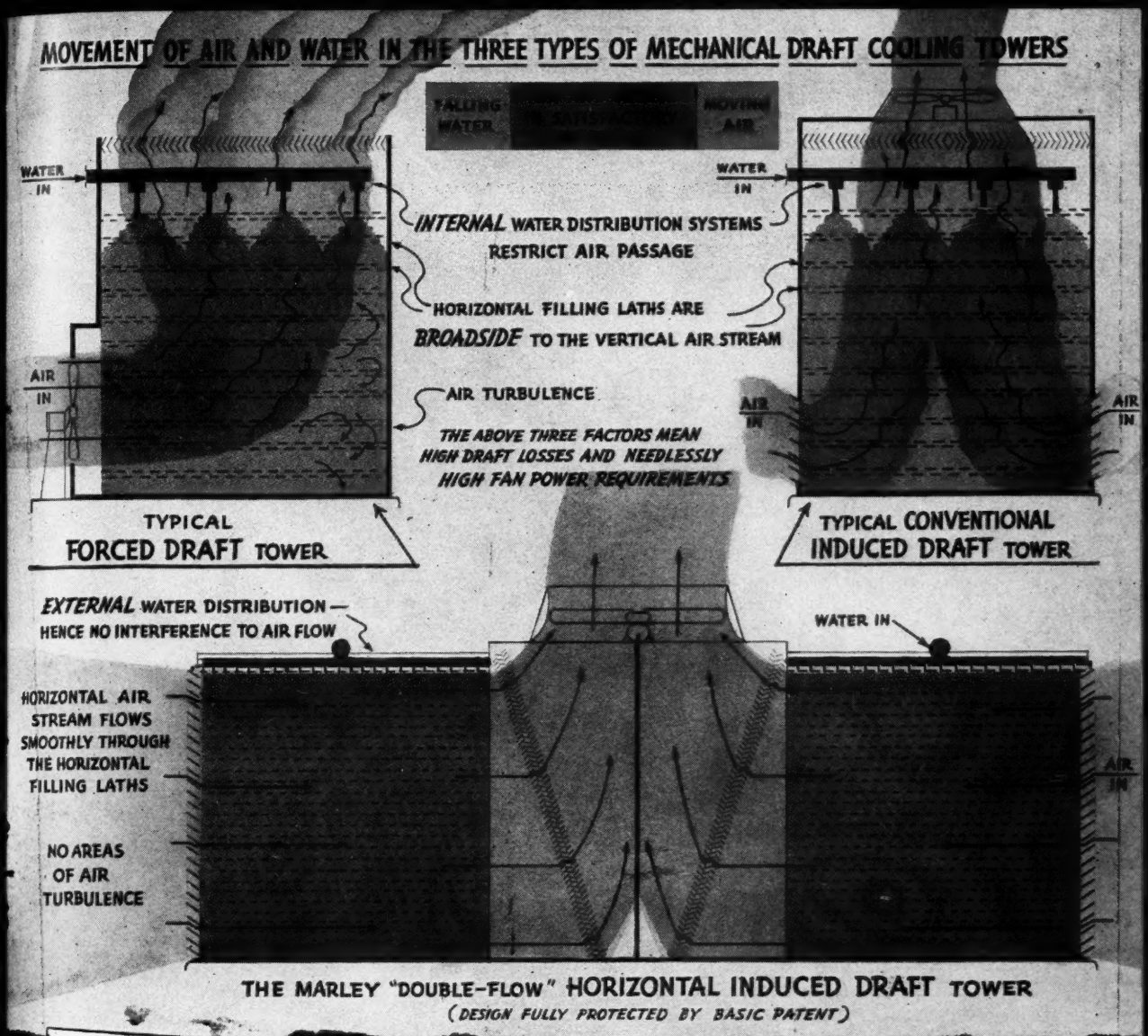
WATER DISTRIBUTION: Complete and uniform distribution of water over the entire cooling chamber is accomplished by evenly spaced nozzles located in the floor of the overhead water distribution basin. This uniformity of water coverage remains constant from top to bottom of the filling.

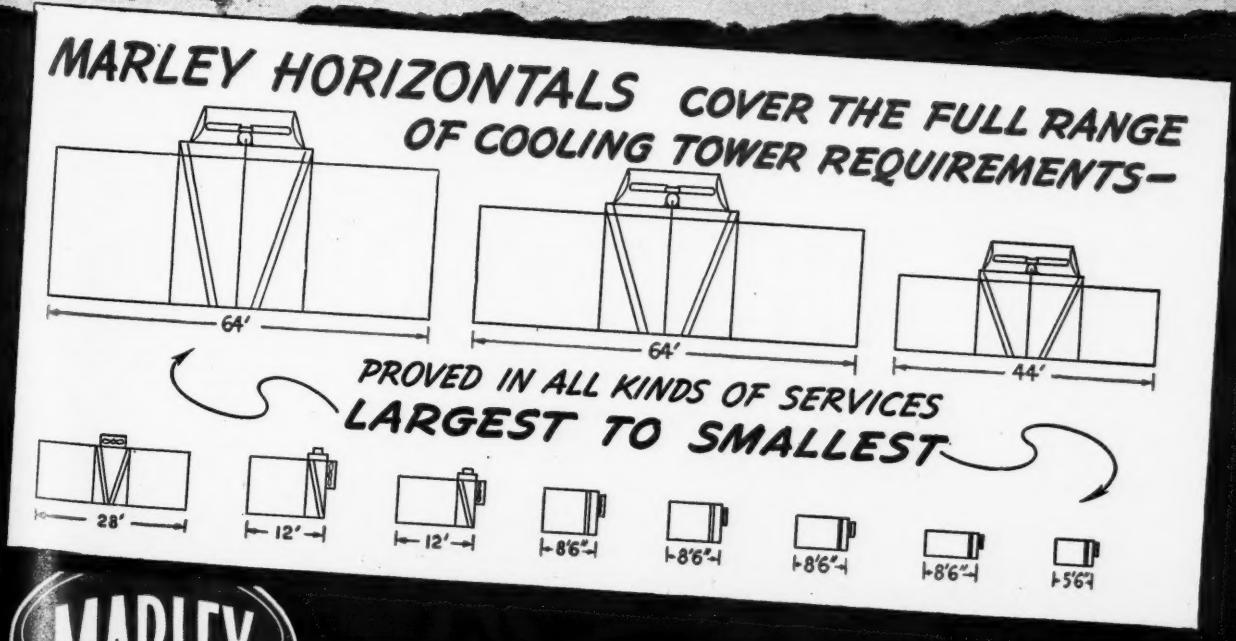
WATER SURFACE EXPOSURE: Initial break-up of water into fine droplets is accomplished by a diffusion deck directly beneath the discharge nozzles. On down through the cooling chamber the filling of staggered laths, on close centers both vertically and horizontally, provides a maximum of break-up and splash surface, a maximum effective wetted surface and minimum air restriction.

Not only does the horizontal cooling tower design achieve a maximum effective heat transfer rate by optimum air-water flow but it also incorporates many other noteable advantages such as

WATER DISTRIBUTION SYSTEM ENTIRELY EXTERNAL
PUMPING HEADS EXTREMELY LOW
BALANCED STRUCTURAL DESIGN, SIMPLE AND RUGGED
ALL PARTS READILY ACCESSIBLE
UNUSUAL OPERATING FLEXIBILITY
POSITIVE DRIFT ELIMINATION
APPEARANCE PLEASINGLY NEAT AND MODERN


NOZZLES IN FLOORS OF BASINS DISTRIBUTE WATER EVENLY OVER FILLING BELOW. CONTROL VALVES PERMIT INDEPENDENT REGULATION OF WATER VOLUME TO EACH "CELL"
DRIFT ELIMINATORS
PARTITION
AIR INLET LOUVERS
ENTIRE DISTRIBUTION SYSTEM OPEN TO VIEW AND EASY TO REACH, EVEN WHILE IN OPERATION
IN ALL SIZES
MARLEY HORIZONTALS
EMPLOY THE SAME SOUND PRINCIPLES OF WATER DISTRIBUTION AND AIR FLOW
IN SMALL MODELS AIR DISCHARGE IS FORWARD INSTEAD OF UPWARD
A TYPICAL "DOUBLE-FLOW" HORIZONTAL
A TYPICAL "SINGLE-FLOW" HORIZONTAL


MOVEMENT OF AIR AND WATER IN THE THREE TYPES OF MECHANICAL DRAFT COOLING TOWERS
FALLING WATER
MOVING AIR
WATER IN
AIR IN
INTERNAL WATER DISTRIBUTION SYSTEMS RESTRICT AIR PASSAGE
HORIZONTAL FILLING LATHS ARE BROADSIDE TO THE VERTICAL AIR STREAM
AIR TURBULENCE
THE ABOVE THREE FACTORS MEAN HIGH DRAFT LOSSES AND NEEDLESSLY HIGH FAN POWER REQUIREMENTS
TYPICAL FORCED DRAFT TOWER
TYPICAL CONVENTIONAL INDUCED DRAFT TOWER
EXTERNAL WATER DISTRIBUTION — HENCE NO INTERFERENCE TO AIR FLOW
HORIZONTAL AIR STREAM FLOWS SMOOTHLY THROUGH THE HORIZONTAL FILLING LATHS
NO AREAS OF AIR TURBULENCE
THE MARLEY "DOUBLE-FLOW" HORIZONTAL INDUCED DRAFT TOWER
(DESIGN FULLY PROTECTED BY BASIC PATENT)

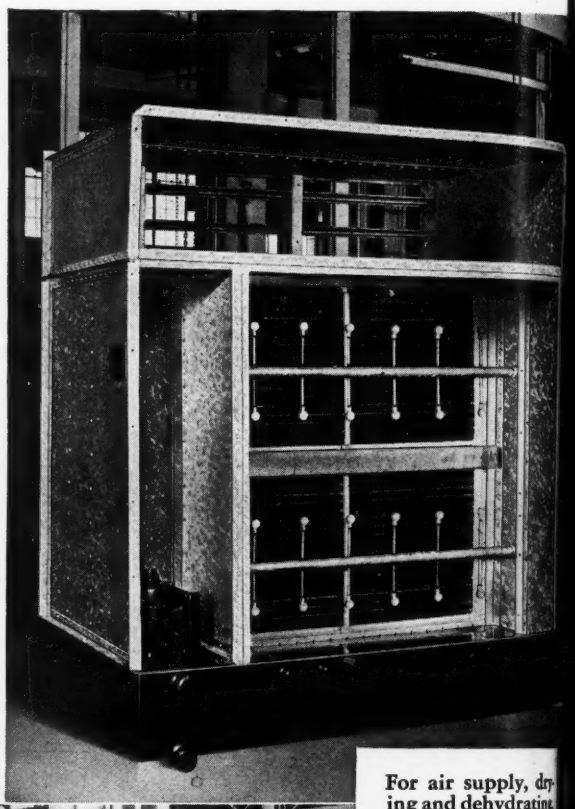


MARLEY COOLING TOWERS

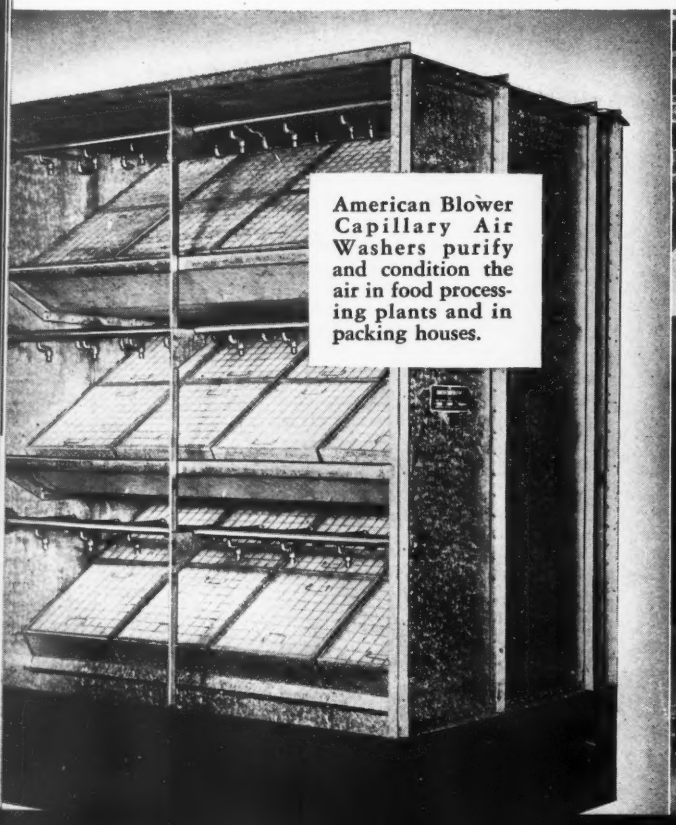
THE MARLEY COMPANY INC.
KANSAS CITY, KANSAS

Progress and Power in the

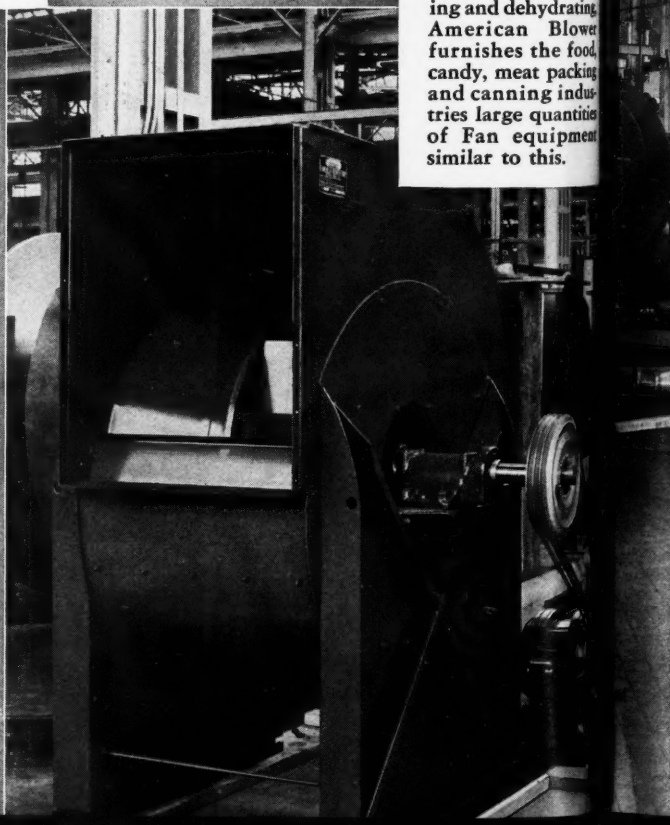
Ample, nourishing food is the prime factor in sustaining Civilian morale and industrial efficiency on the home front, and in building the fighting vigor of America's armed forces on land and sea and in the air. In this march to Victory through food, American Blower Fans, Air Washers and Centrifugal Collectors play their part as essential equipment . . . are of special value in the processing of the dehydrated and powdered foods to save cargo space. The Public Utilities, too, which are supplying an ever increasing amount of electric energy to the food industry and to all war industries, are daily finding the true value of American Blower Mechanical Draft equipment, Fluid Drives and Dust Collectors. In war and in peace, American Blower serves America.



For air supply, drying and dehydrating American Blower furnishes the food, candy, meat packing and canning industries large quantities of Fan equipment similar to this.



American Blower Capillary Air Washers purify and condition the air in food processing plants and in packing houses.



AMERICAN BLOWER

ARMY E NAVY

For Production "Well Done"

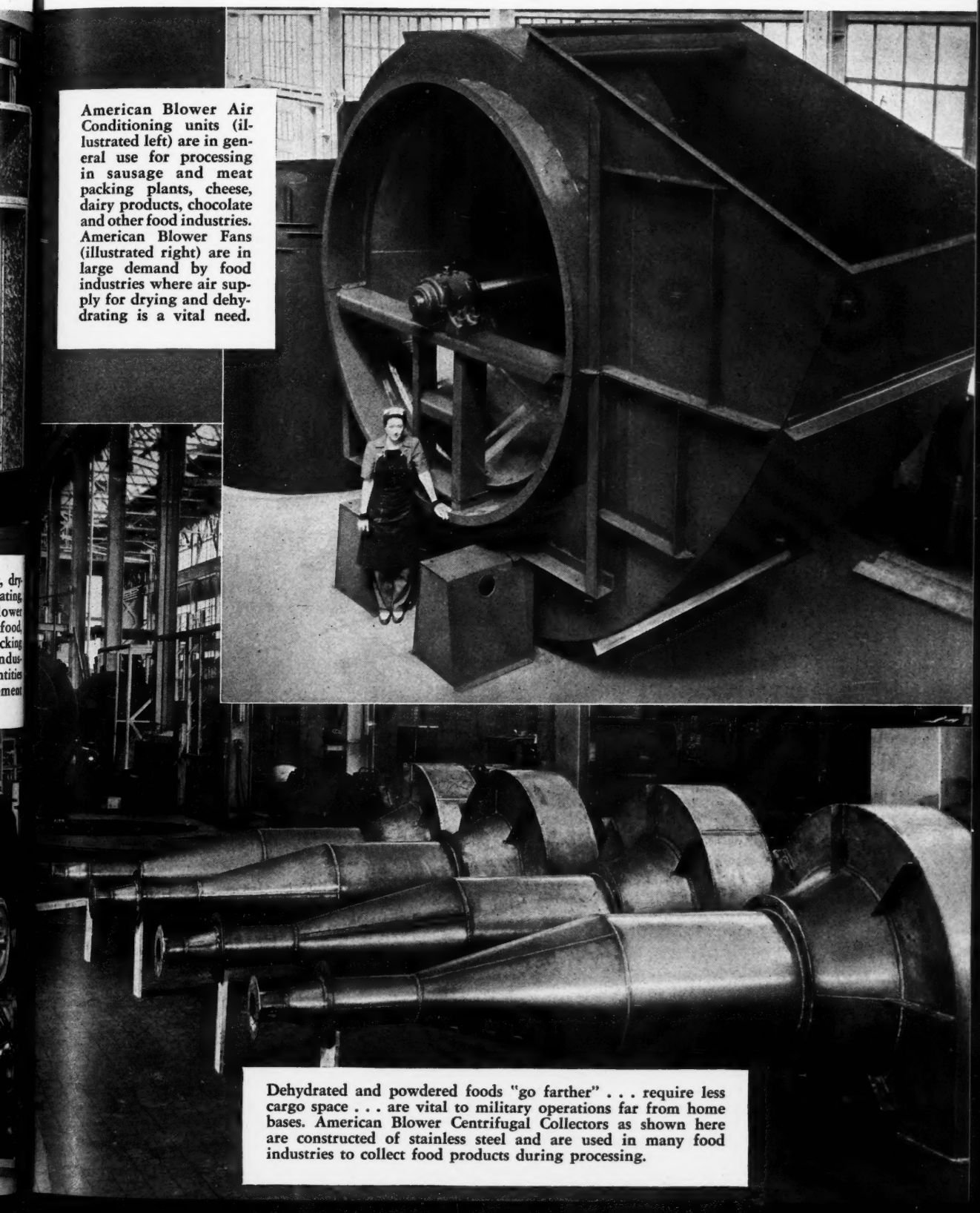
AMERICAN BLOWER CORPORATION, DETROIT, MICH.

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

Division of American Radiator and Standard Sanitary Corporation

OOD *and* PACKING INDUSTRIES

American Blower Air Conditioning units (illustrated left) are in general use for processing in sausage and meat packing plants, cheese, dairy products, chocolate and other food industries. American Blower Fans (illustrated right) are in large demand by food industries where air supply for drying and dehydrating is a vital need.



Dehydrated and powdered foods "go farther" . . . require less cargo space . . . are vital to military operations far from home bases. American Blower Centrifugal Collectors as shown here are constructed of stainless steel and are used in many food industries to collect food products during processing.

Uniformity, dependability, high quality... these are the features that make J-M Service Sheet the No. 1 Sheet Packing for industry

MORE AND MORE engineers are safeguarding gasket performance by switching to J-M Service Sheet. Basically asbestos, this tough material not only stands up longer, but is completely uniform, both in density and quality. Because it does not deteriorate with age, it can be kept in stock indefinitely.

If you're not already using J-M Service Sheet, it will pay you to investigate. And if you have any other packing problems, you'll find an efficient, economical solution in the balance of the complete J-M line. For details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

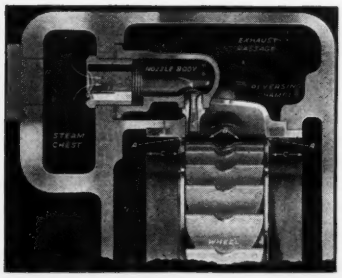
● With virtually the entire production of J-M Packings and Gaskets needed for war, delivery on other than high-priority orders may be slower than in normal times. However, through increased capacity and round-the-clock production, every step is being taken to assure the fastest delivery possible under the present emergency.

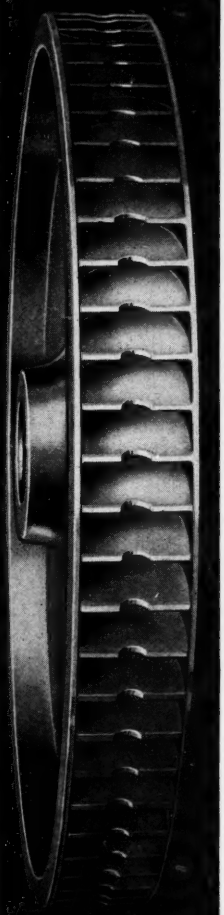
JM

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

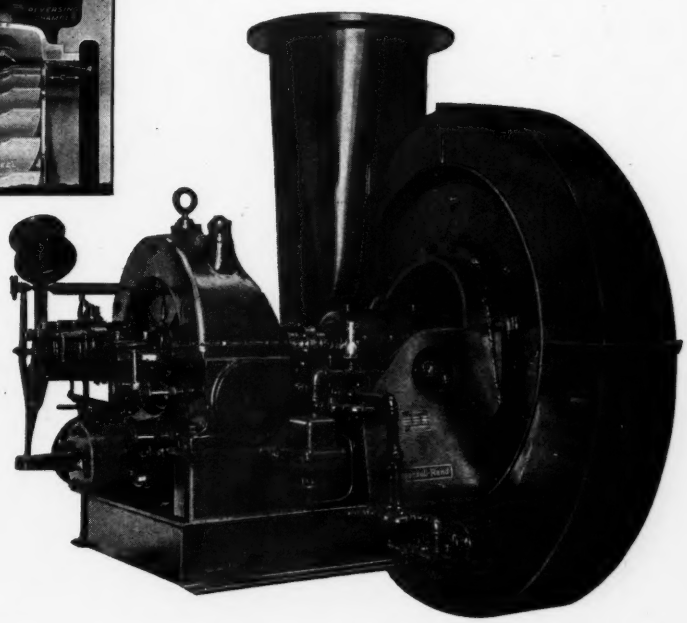
TERRY





ABOVE:
Terry Wheel Clearances. A-Rim Clearance. B-Large Blade Clearance. C-Side Clearance (about one inch).

AT RIGHT:
Typical Terry Solid Wheel Turbine direct connected to a blower.



THE BLADES ARE DOUBLE RIM PROTECTED
IN THE TERRY SOLID WHEEL TURBINE

In the Terry Turbine the blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced.

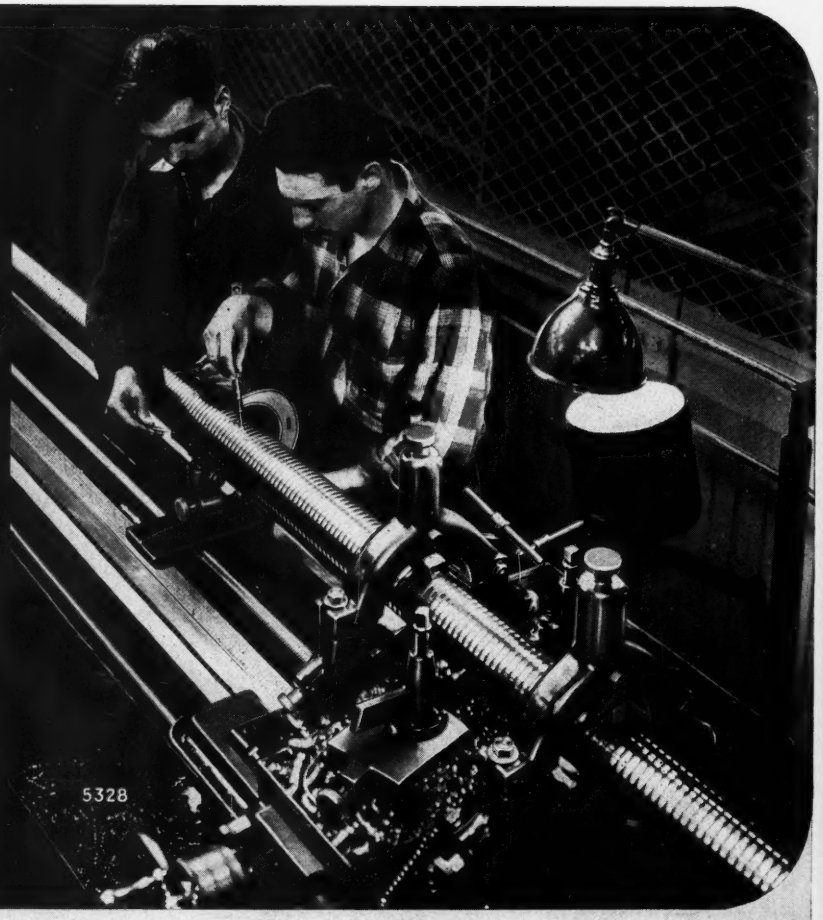
End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end trust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

The Terry solid wheel turbine is described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1146

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

THE *Master* LEAD SCREW



Making a Precision Lead Screw.

The lead screws used in the gear generating machines which produce De Laval Helical Gears for transmitting the power of high-speed steam turbines and also in the thread milling machines on which the worms for De Laval worm gears are made must be extremely accurate, since tolerances are measured in ten-thousandths of an inch.

Lead screws of the precision required not being generally available, it has from the beginning been the practice of the De Laval Steam Turbine Company to cut its own lead screws. The precision lead screw cutting lathe here shown, after exhaustive checking and the incorporation of certain refinements by our engineers and shop specialists, produces lead screws of the necessary accuracy.

The machine's own carefully corrected original or master lead screw is protected and carefully preserved. A duplicate which has been cut from the original and can readily be replaced when worn or injured is used in regular operation.

This is one of the factors contributing to the outstanding success of the many millions of horsepower of De Laval Gears now in service upon American Naval and merchant vessels and in industrial applications.

M-35

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

MANUFACTURERS OF TURBINES... STEAM, HYDRAULIC; PUMPS... CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS... WORM, HELICAL; and FLEXIBLE COUPLINGS

AIR is LIFE to a stratosphere pilot...

BUT DEATH TO UNSTABLE TURBINE OILS!

NO MATTER what kind of turbine you operate, air bubbles are going to get into the oil. As a result, a constant battle is waged between oil and air. And once oxidation gets the upper hand over an unstable oil it breaks down rapidly.

However, this is not true of Shell Turbo Oil. For this history-making oil has the ability to resist oxidation to a degree never before thought possible in turbine oil operation.

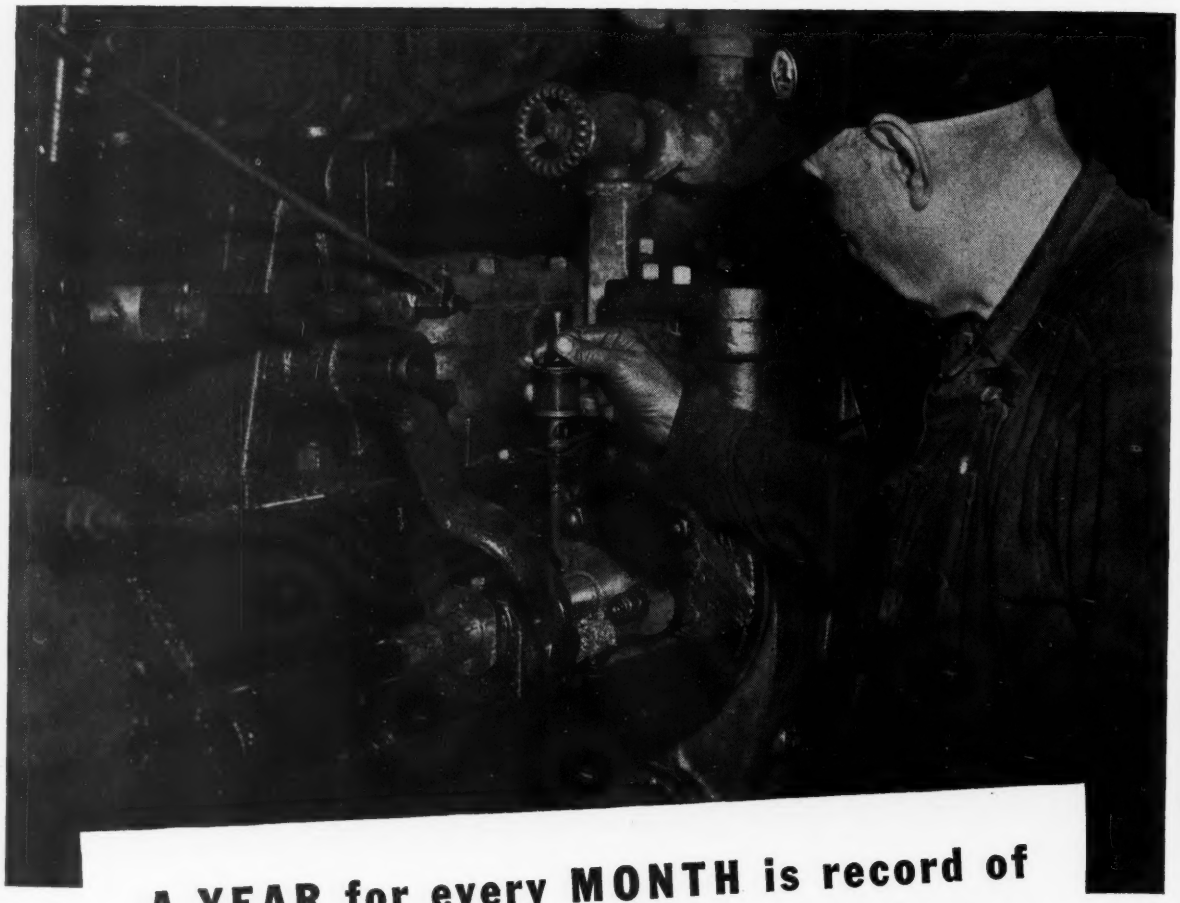
But in today's high speed turbines even *oxidation stability* is not enough. A turbine oil must also be able to *prevent rust.* Shell Turbo Oil has both of these requirements necessary to economical, trouble-free turbine operation. And it's because of these superior qualities that more and more operators are draining, flushing and refilling their turbines with Shell Turbo Oil.

For full details call in the Shell man. Or, write Shell Oil Company, Inc., Dept. "F," 50 W. 50th Street, New York 20, N. Y. or 100 Bush Street, San Francisco 6, Calif.

SHELL

SHELL TURBO OIL

Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil



A YEAR for every MONTH is record of MONEL replacing bronze pump rods

In 1930, the Lima Locomotive Works, Inc., Lima, Ohio, replaced worn bronze rods in three boiler feed pumps with Monel.

The bronze rods, used on pumps that supply water to seven boilers, had lasted only 10 to 12 months. The water is extremely corrosive, being high in sulphur content, and the rods are exposed to soot, coal dust and sand.

Today, more than 12 years later, the Monel rods are still at work . . . giving a year, and more, of service for every month given by the bronze!

The Monel rods are mirror smooth, with only slight longitudinal grooves. In twelve years of steady service . . . as long as three weeks at a time without a moment's stop . . . they have worn down less than 1/16" in diameter. They are expected to last at least another year before replacement.

In the words of W. N. McConkey, Shop Engineer at the Lima Works, "When we put in the Monel rods, we expected them to save us some of the rod troubles we used to have with those pumps. We hoped they would last three or four years . . . but we never expected that they would last more than 12 years."

Monel, installed by foresighted management long before the war, is providing extra, trouble-free service today, when replacements are so difficult to obtain.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK 5, N.Y.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

No. 6 in a series of tributes to America's War Industries

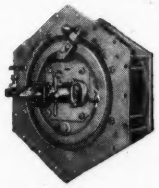
RIDING ROUGHSHOD OVER NAZI WOLFPACKS

A caravan of ships . . . fat and heavy with cargo . . . plows along steadily, relentlessly. All around it, sleek escort ships race hither and yon, like bird dogs, sniffing every wave for enemy U-boats. Perhaps a wolfpack will attack. Maybe it will tag a few of these sturdy freighters. But it will pay dearly. And for every ship the subs manage to sink, American industry sends **many more* out to take its place.

One of the factors that is putting an end to the Axis submarine menace is the overwhelming numerical weight of the ships we are sending to sea. To achieve such a stupendous output, American industry has revolutionized shipbuilding methods . . . is speeding ship repair at a record-breaking pace.

It's one of the great accomplishments of the war, this success in our shipping program. And it is typical of the endless string of victories . . . all along our production lines . . . that mark the effort of American industry to help win unconditional surrender — and quickly!

**NOTE TO THE ENEMY—Wouldn't you like to know how many?*



IN SHIPS OF ALL TYPES

TODD BURNERS

ARE WORKING FOR VICTORY

In countless ships, merchant and fighting, and in war plants of all types . . . wherever trouble-free, dependable combustion is a necessity . . . Todd Burners are delivering unsurpassed performance in the production of heat and power.

Buy MORE
War Bonds and Stamps

TODD SHIPYARDS CORPORATION

TODD COMBUSTION DIVISION

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NEW YORK · MOBILE · NEW ORLEANS · GALVESTON
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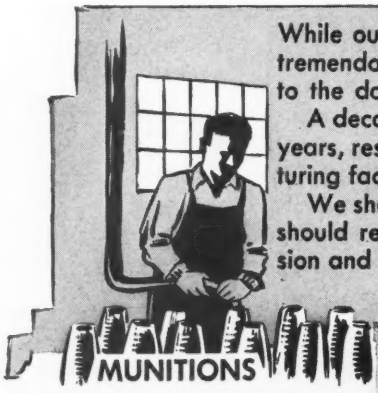
TODD BURNERS ★ ★ ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

WHAT *War Production*

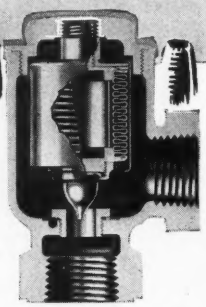


While our plant is striving twenty-four hours every day to keep pace with the tremendous wartime demand for standard Sarco products, we like to look ahead to the days when peace is restored.

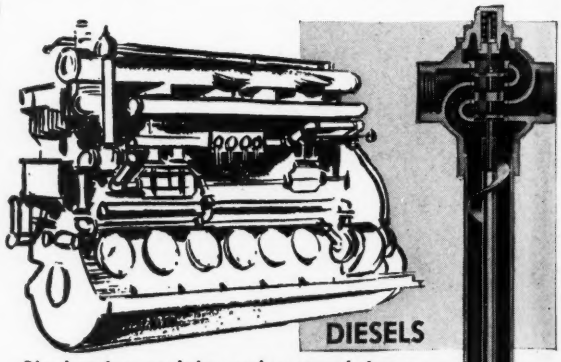
A decade of experience and development is being crowded into these war years, resulting in significant improvements in our designs as well as our manufacturing facilities.

We show here a few reasons why Sarco steam traps and temperature control should receive first consideration in connection with your plans for re-conversion and new construction.

MUNITIONS



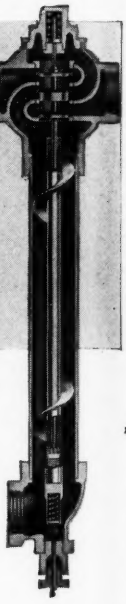
Use of processing equipment in shell loading plants, powder and explosives factories has multiplied many times the demand for the always popular Sarco Thermostatic Steam Trap. Ten years would have been needed to provide the same endurance test for the unique Sarco bellows which makes this trap successful at pressures up to 250 lbs. New facilities for streamlined quantity production will keep it in the lead wherever steam is used for its heat. Catalog No. 250

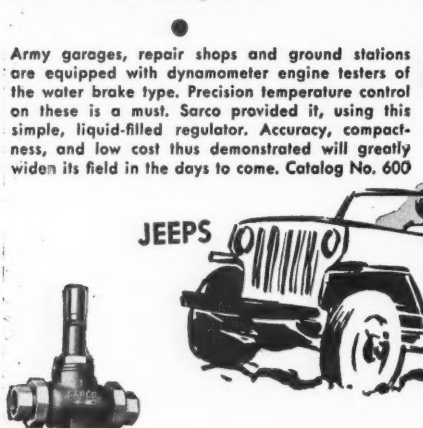


DIESELS

Diesel engines are being used as never before on Navy and merchant vessels of many types both for propulsion and as generator sets.

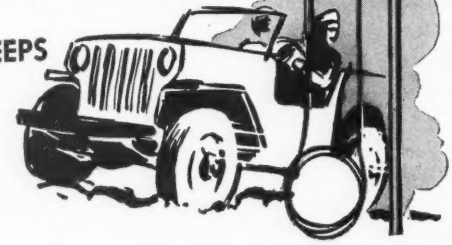
Hundreds have been equipped with Sarco Water Blenders as jacket water cooling controls. Their faultless performance assures you of tested, proven equipment for every type of cooling circuit on engines, compressors, condensers, stills, etc. Catalog No. 700



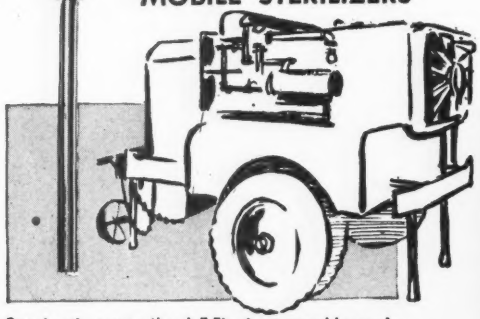


Army garages, repair shops and ground stations are equipped with dynamometer engine testers of the water brake type. Precision temperature control on these is a must. Sarco provided it, using this simple, liquid-filled regulator. Accuracy, compactness, and low cost thus demonstrated will greatly widen its field in the days to come. Catalog No. 600

JEEPS

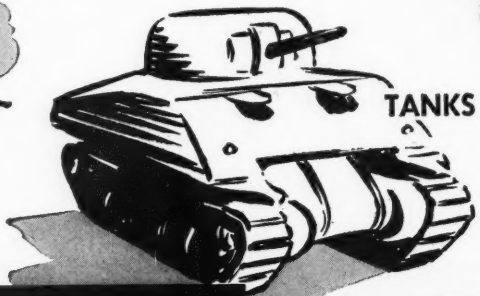


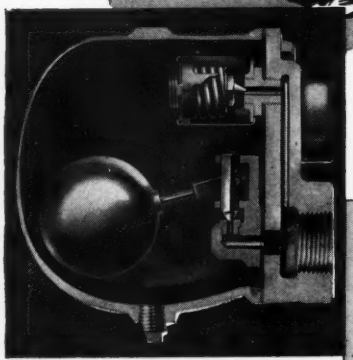
MOBILE STERILIZERS



Prominent among the A.E.F's. incomparable equipment for army field hospitals are mobile combination sterilizers and water heaters. Constant water temperature is assured by a Sarco regulator so compact that it literally "melts" into the piping. Quantity production brings them within reach of all users of hot water after the war. Catalog No. 600

TANKS





Heating the great aircraft factories, tank arsenals, and ordnance plants has been done largely with unit heaters, with Sarco float-thermostatic steam traps removing the condensate and air rapidly and continuously. It is the favorite trap with heating engineers on mains, risers, and fan units. Catalog No. 450

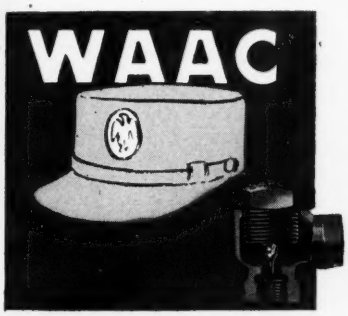
SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.
Represented in Principal Cities

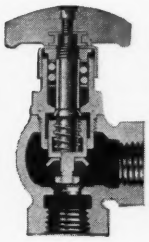
IS TEACHING US

ESCORT VESSELS

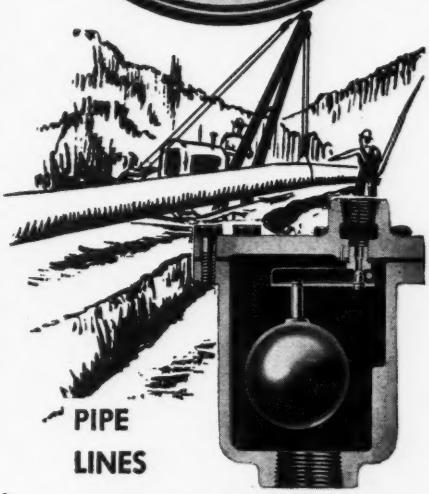
Sarco Inverted Bucket Steam Traps are used by the Navy in large numbers on many types of ships, including the new DE escort vessels.

A trap that will function faultlessly under the conditions of rolling and pitching on a ship and the shocks of gun explosions is a good trap to use on the hardest service found on land. Catalog No. 350





These simple but efficient radiator traps and supply valves were used in new barracks, cantonments, training stations for all the services. While meeting wartime requirements, they preserve essential features, making for long, trouble-free service in buildings of all types. Catalog No. 160



PIPE LINES

War emergency pipe lines in this country and on the war fronts of the world created a demand for a new type of air vent to eliminate air from lines handling fuel oil or 100 octane gasoline at pressures sometimes as high as 600 p.sq.in.

To its already broad line of vents for steam and water lines, Sarco has added new types which will be welcomed in the chemical and petroleum industries and in power plants. Catalog No. 170

●

A significant war development is hard chromium plating for wearing surfaces, as on dies. Sarco has equipped many of these plating plants with new electric controls for both heating and cooling. Their simplicity and low cost commend them to metal finishers and for many other uses. Catalog No. 1025

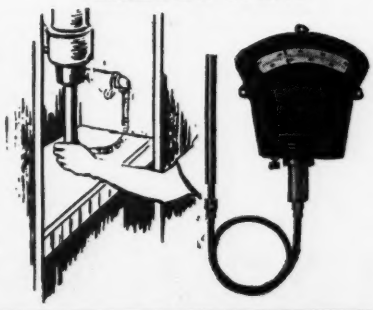
Mechanizing the U. S. Army did not stop with tanks and jeeps. It went right down into the kitchens, where electric dishwashers make short work of what used to be a distasteful task. Sarco designed a combination steam injector and temperature control for these, so simple, foolproof and inexpensive that it will find wide application wherever direct contact water heating is used. Catalog No. 550

V-MAIL FILM

Development of V-Mail film is an assembly-line operation. To make it automatic, Sarco furnished this ingenious mixing valve to provide blended water at exactly the right temperature.

It is ideal not only for film washing, but for group wash basins and wash water in dairies or packing houses, or for process hot water. Catalog No. 800

AIRCRAFT PARTS



SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

IRON FIREMAN STOKER

Helps take 90% of Water out of Foods

F. B. Huxley (*center*), owner of the largest food dehydration plant in the East, talks over plans with Superintendent Frank J. Vandewater and Manager Frank S. Haugh.

The boiler room is spic-'n'-span with this double nozzle Iron Fireman Pneumatic Spreader stoker conveying coal to the 489 horsepower Springfield Watertube boiler. When this plant was hand-fired, objectionable black smoke was produced. Now, with Iron Fireman automatic coal firing, there is no smoke nuisance.

Iron Fireman Pneumatic Spreader Stoker Speeds Production for Big New Dehydration Plant

IN a global war, the transport of food, supplies, and munitions to our soldiers and allies is a most vital problem. Nothing has done more to save cargo space and speed transport than the dehydration of foods. F. B. Huxley & Son of Ontario, New York, "de-water" cabbage, potatoes, beets and other vegetables by removing nine-tenths of their moisture content. Then the dried foods are compressed, saving more cargo space. The greatly reduced weight and bulk of the foods permits one ship to carry the equivalent of nine shiploads of the original form.

At this modern processing plant, which requires carefully controlled heating conditions for steaming and drying, it is being proved daily that fewer tons of coal can carry a heavier load, when fired automatically.

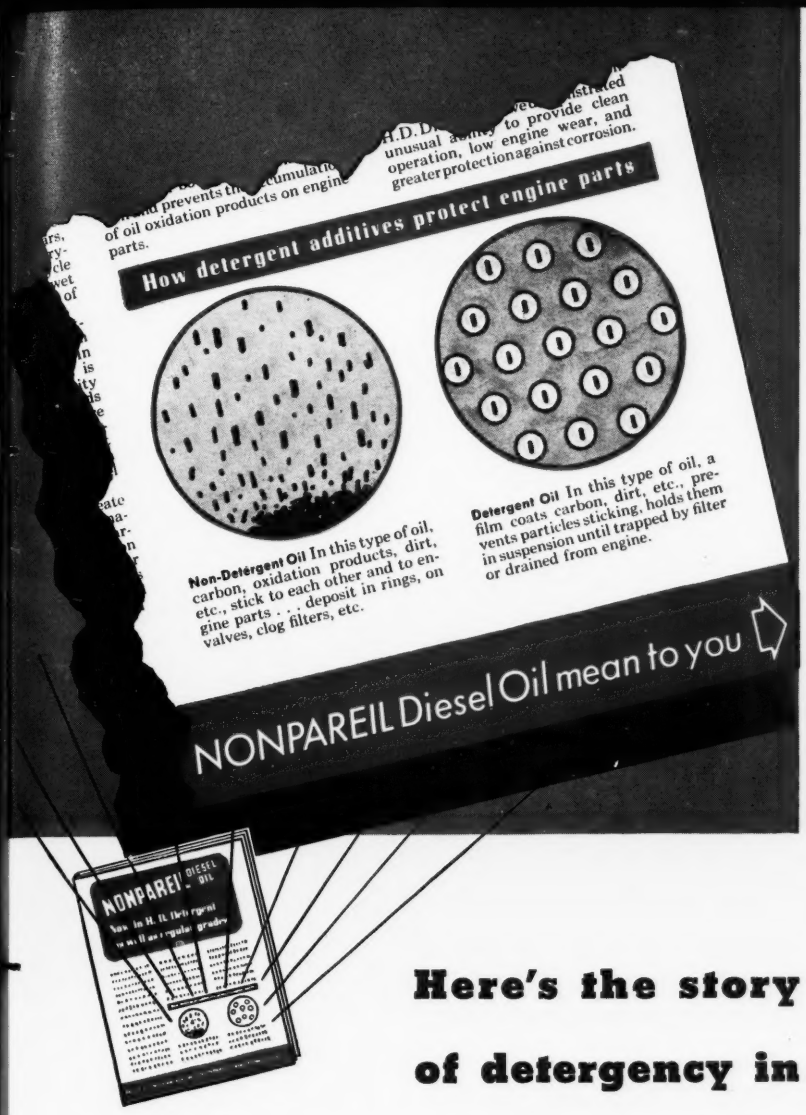
Frank J. Vandewater, the superintendent, says: "When we hand-fired, we used 20 tons of coal a day in mild weather. When we installed the Iron Fireman Pneumatic Spreader, we increased our load one-third, and yet we use only 18½ tons a day, even with temperature down to 20° below zero.

"The design of the Iron Fireman Pneumatic Spreader stoker makes it easy to operate, and very well adapted to our constant 24-hour load. The light fragmentary ash and complete absence of large, hard clinker formation is a delight to our firemen."

Iron Fireman Stokers Now Available

Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Co., 3520 W. 106th St., Cleveland 11, Ohio. Iron Fireman Manufacturing Co., Portland, Oregon; Cleveland; Toronto.

IRON FIREMAN AUTOMATIC COAL STOKERS


How detergent additives protect engine parts
Non-Detergent Oil In this type of oil, carbon, oxidation products, dirt, etc., stick to each other and to engine parts . . . deposit in rings, on valves, clog filters, etc.
Detergent Oil In this type of oil, a film coats carbon, dirt, etc., prevents particles sticking, holds them in suspension until trapped by filter or drained from engine.
NONPAREIL Diesel Oil mean to you

Here's the story of detergency in new Nonpareil H. D. Diesel Oil

. . . detergency, plus high oxidation stability, bringing new engine cleanness, notable wear reduction, and longer oil life

● If you're having trouble with ring-sticking, piston scuffing, excessive carbon, sludge, or gum deposits, you'll want to read this bulletin, "Nonpareil Diesel Oil—now in Detergent as well as Regular Grades." It gives laboratory and field-tested facts which show that the troubles mentioned above can be practically eliminated by the use of new Nonpareil H. D. Diesel Oil.

This detergent-type addition to our Nonpareil line brings a new degree of engine cleanness. It not only *keeps* engines cleaner, but in many cases will remove deposits left by other oils. The detergency (see diagram) comes from an additive which is both a detergent and an oxidation inhibitor.

Wherever Nonpareil H. D. Diesel Oil has been used, the results have been outstanding. The cleanness and improved engine operation have been quickly noticed.

Where to use detergent-type oils. Our regular line of Nonpareil Diesel Oils, over a long period of years, has established a fine record for engine cleanness and low wear. In fact, many engines give clean operation with these regular-type oils. But where dirty operation cannot be corrected by mechanical adjustment, the use of the new detergent-type Nonpareil H. D. is recommended.

A Standard Lubrication Engineer will gladly advise you which type and grade will give you the best possible results in your Diesels. Why not make a test in some unit in which conditions are severe? Phone or write for the Engineer nearest you.

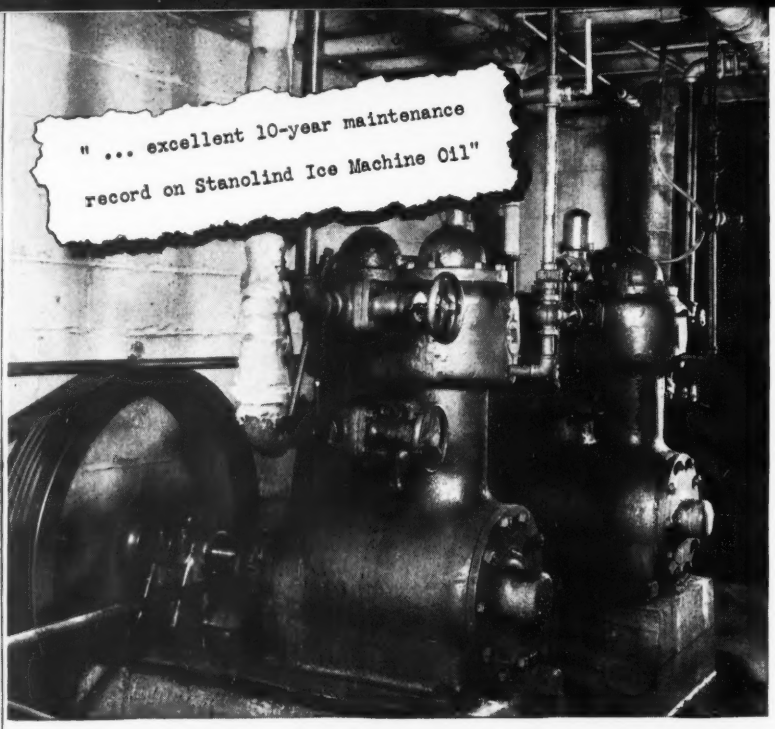
Send for Bulletin. Get the full facts about this great new oil. See how its characteristics fit it to handle difficult service conditions. Note its applications to various makes and models of Diesels, etc. Send now for your copy of our Nonpareil Diesel Oil Bulletin. Write or call any Standard Oil Company (Indiana) office, or 910 S. Michigan Ave., Chicago 5, Ill. In Nebraska, address Standard Oil Company of Nebraska at Omaha 2.

Oil is ammunition . . . Use it wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION

RICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION



These two York ammonia compressors in a Minnesota dairy, and a similar installation in a large ice plant, have made excellent maintenance records in 10 years' operation on Stanolind Ice Machine Oil.

How Minnesota plant guards compressors against "absenteeism"

• IN THESE DAYS of all-out production, there must be no costly shutdowns of refrigerating machinery for repairs ... there must be fewer replacements of bearings, pistons, and other hard-to-get parts. Power and oil consumption must be held to a minimum. The following letter shows how a Minnesota ice plant is saving on all three points.

"We have been using Stanolind Ice Machine Oil in our two York Ice Machines for the past ten years. And in that time, we have had absolutely no bearing trouble ... no bother with oil congealing ... oil consumption has never been excessive."

For you, as for hundreds of other users of refrigerating equipment throughout the Middle West, Stanolind Ice Machine Oil can also give protection against many needless shutdowns —can aid in your victory effort to produce more with less power, labor, and maintenance. Stanolind has what it takes to hang on a long time: high stability; low pour point; marked resistance to formation of harmful acids and sludge.

Two heads are better than one in licking your lubrication problems. What new equipment is available ... where to get replacement parts ... how to get and train new personnel? The list of new operating problems in every industry is long and varied. But don't overlook the importance of good lubrication in preventing breakdowns before they happen. A Standard Lubrication Engineer near your plant is ready to work with you on your troublesome lubrication worries. Because of his many contacts with other plants similar to yours, he may already have the answer to many of your questions about better machine maintenance, reduced power consumption, etc. Call any Standard Oil Company (Indiana) office, or write 910 S. Michigan Ave., Chicago 5, Ill., for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Oil is ammunition ... Use it wisely

Practical tips on refrigeration compressor lubrication

Avoid excess oil in compressor cylinder lubrication. Much less oil is needed than for steam engine cylinders of equal size. Oil is not washed away, as it is in steam engines, nor burned, as it is in internal combustion engines. It remains in the cylinder a long time, and for that reason large quantities of oil are not needed.

In splash systems the oil level should not be carried too high, as the churning will throw too much oil into the system and make removal by the separator difficult.

Oil separators should be located near the condenser, and as far as possible from the compressor, to allow precipitation of any oil mixed with the gas.

Oil from traps should not be used again without purification, as many contaminants are collected in the traps along with the oil.

Lubricant recommendations depend in a great measure upon the type of refrigerant used, method of lubricating, and individual characteristics of design of your installation. A Standard Lubrication Engineer will gladly study your requirements and recommend the most economical oil for your needs.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

"...if you'll send us the guns!"

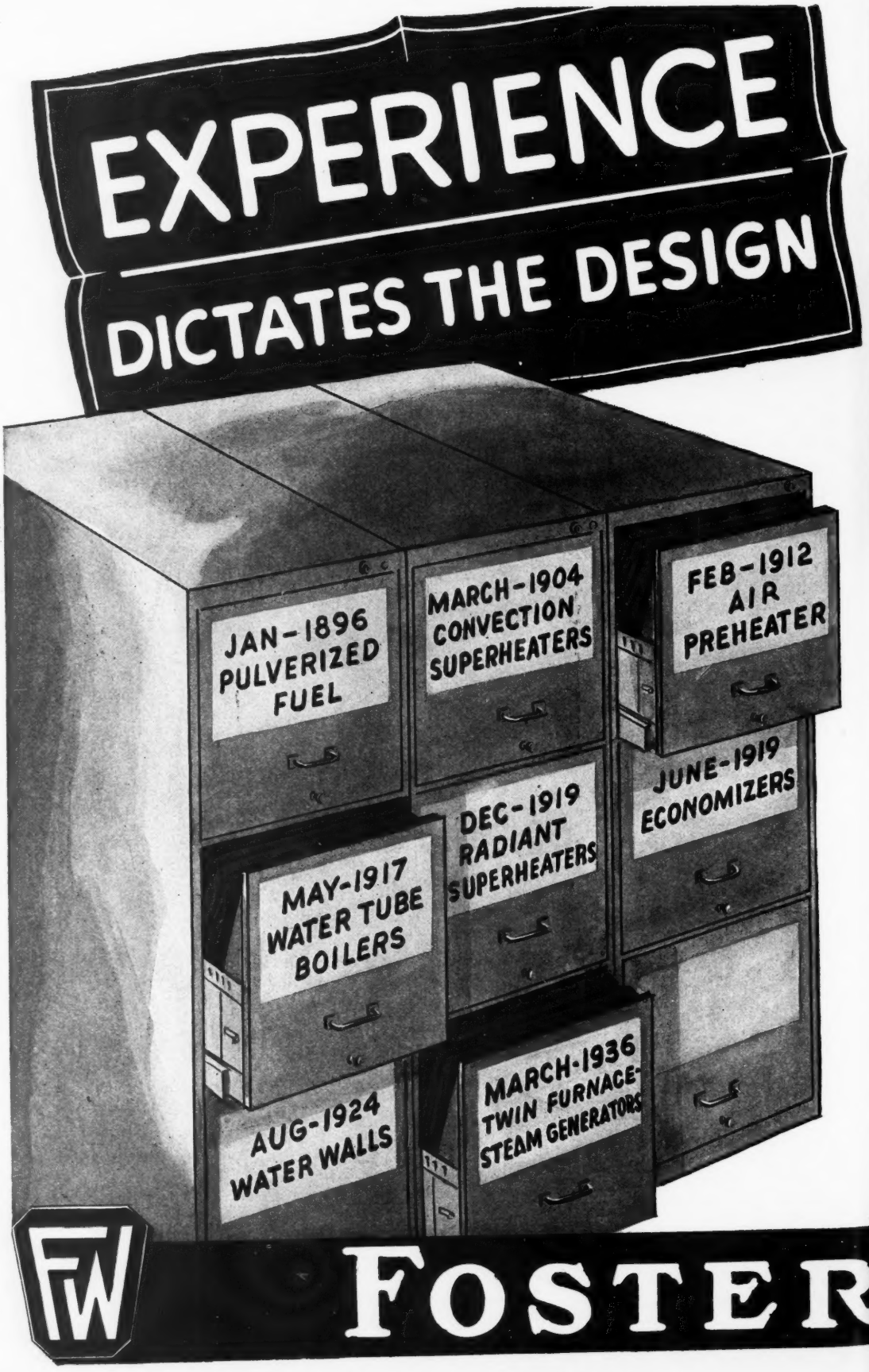
Our boys will gladly risk their lives for Freedom. All they ask of us back home is that we send them the guns, shells and equipment—and send it *fast*. They'll do the rest. So let's keep production zooming along at top-speed. One way to help speed production is to use Garlock Packings, Gaskets and Oil Seals—they give long, dependable service and help you avoid frequent shut-downs.

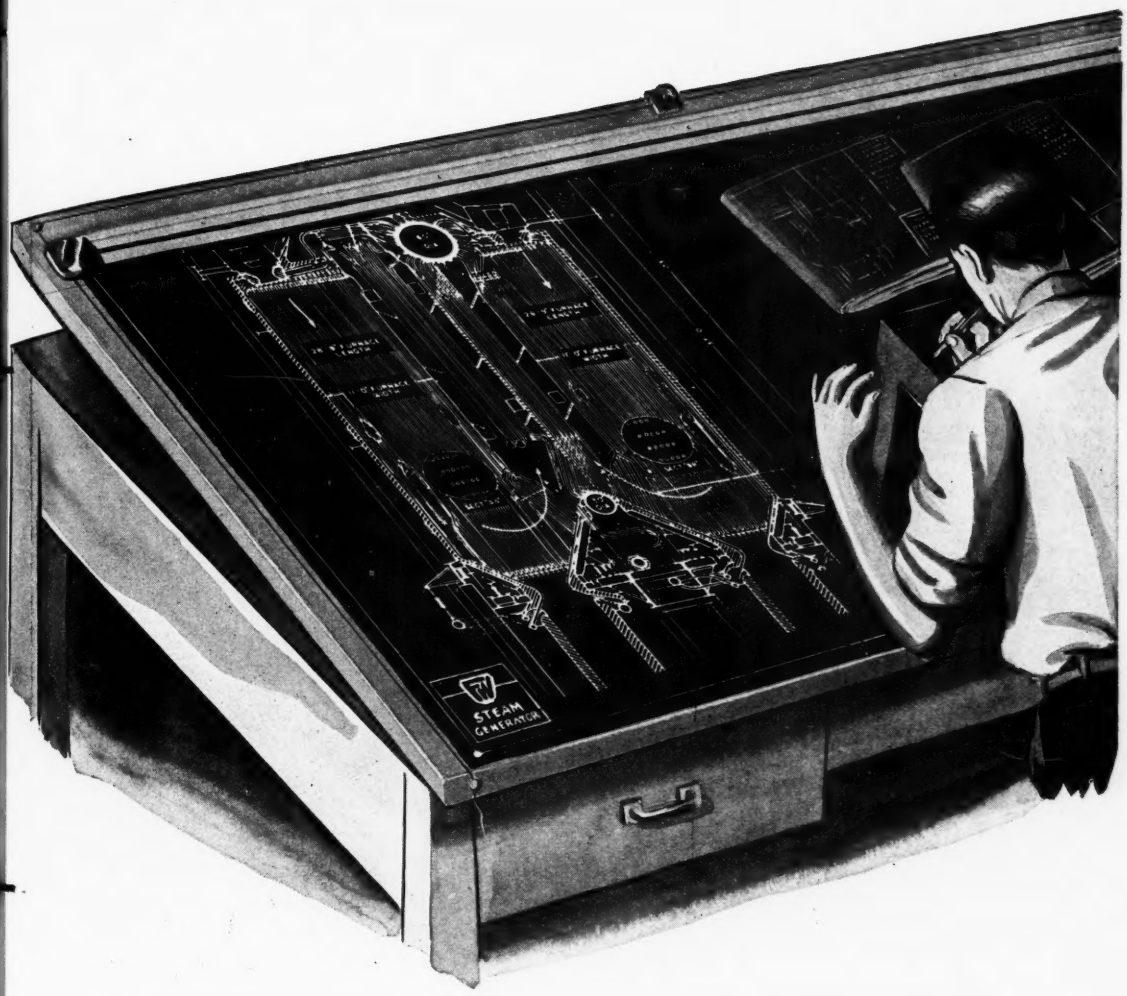
Garlock

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.


EXPERIENCE
DICTATES THE DESIGN
JAN-1896 PULVERIZED FUEL
MARCH-1904 CONVECTION SUPERHEATERS
FEB-1912 AIR PREHEATER
JUNE-1919 ECONOMIZERS
DEC-1919 RADIANT SUPERHEATERS
MAY-1917 WATER TUBE BOILERS
AUG-1924 WATER WALLS
MARCH-1936 TWIN FURNACE-STEAM GENERATORS
FW
FOSTER

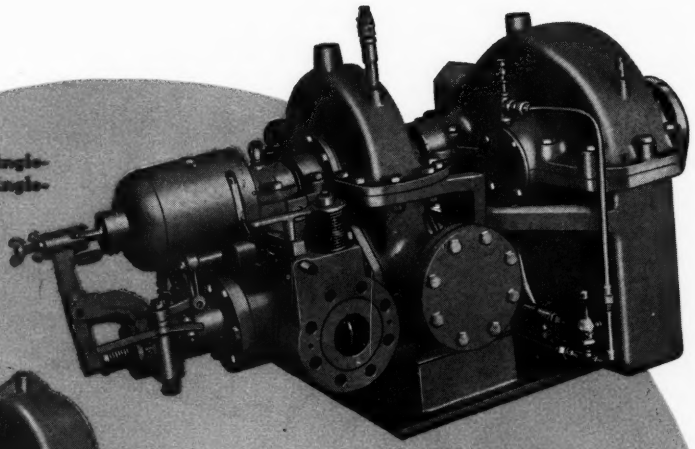


The prime requisite of EXPERIENCE—predominating factor in the successful engineering of any power plant —contributes exceptionally to designs developed by Foster Wheeler. Half a century of experience combined with efficient shops, progressive engineering, active research assures economic installation and operation.

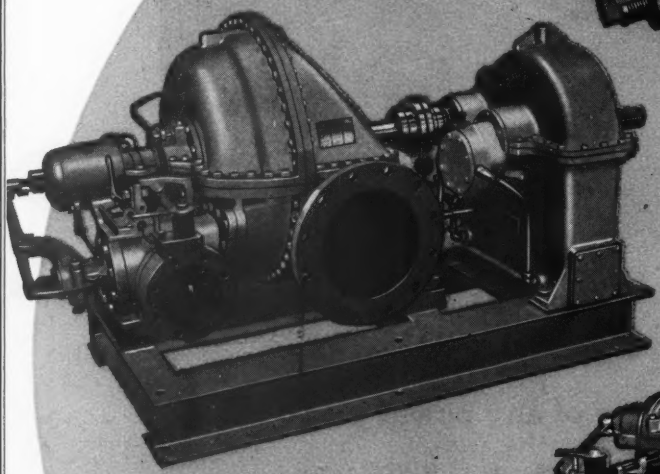
FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK, N. Y.

WHEELER FW

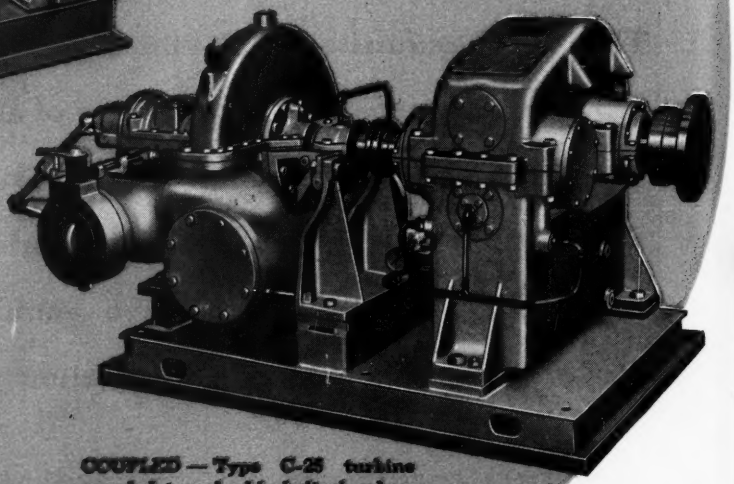
GEARED steam drive



INTEGRAL — Type C-20 single-stage turbine with integral, single-helical reduction gear.



COUPLED—Type C-225 multi-stage turbine, with a coupled, double-helical reduction gear.



Forced feed lubrication for turbine and gear is provided on Westinghouse geared units and includes oil pump driven from gear shaft, external oil cooler and gear base oil reservoir.

COUPLED — Type C-25 turbine coupled to a double-helical reduction unit.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

DESIGNED FOR YOUR SPEED!

STEAM HEADQUARTERS HAS THE GEARS TO MATCH THE TURBINE

INTEGRAL OR COUPLED GEAR RATIOS FROM 2-TO-1 THROUGH 14-TO-1

Where machinery must be driven at speeds lower than economical turbine speeds, Westinghouse can supply the right reduction gear to permit operation of both turbine and driven equipment at favorable speeds. These are not ordinary gears. They are built *specifically* for use with turbines—and each unit falls heir to millions of horsepower of gear experience, both land and marine.

EASY ALIGNMENT. In the Westinghouse design, the entire unit is supported at three points by machined pads. This arrangement prevents distortion of the housing and facilitates alignment with driven apparatus.

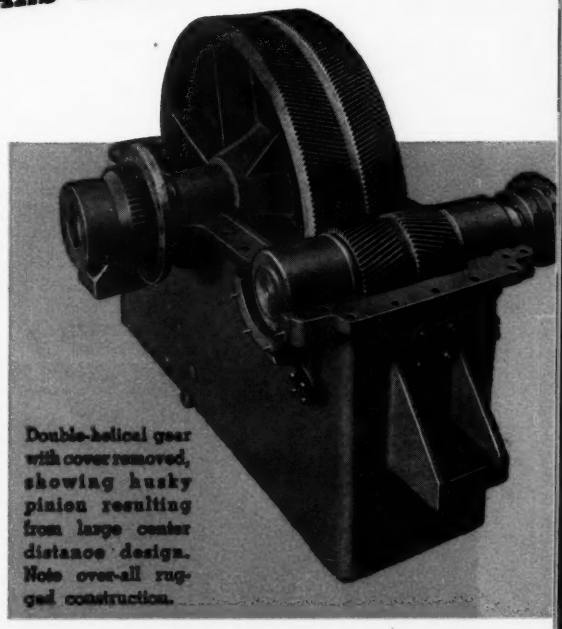
ACCURATE TEETH. Gear cutting is conducted scientifically from drawing board to test floor. Westinghouse hobbers maintain extreme accuracy. No scraping, lapping or buffing is permitted. After assembly with its turbine, each gear is given a running test and noise checkup.

LOW TOOTH DEFLECTION. By using a relatively narrow active tooth face width and a relatively large distance from the pinion centerline to the gear centerline, Westinghouse obtains unusually low tooth deflection. The resulting conservative tooth pressures are a vital factor in trouble-free operation.

ADEQUATE LUBRICATION is provided by a circulating oil system. A spray of oil is directed into the meshing teeth to assure ample lubrication at the tooth contact.

No matter what steam drive problem you may have, come to Steam Headquarters. Here is industry's most complete line of turbines, gears and steam auxiliaries . . . competent engineering help . . . and a convenient, nationwide service organization of steam experts. Westinghouse manufacturing capacity is and will be adequate for both national defense and commercial production.

J-50438



Double-helical gear with cover removed, showing husky pinion resulting from large center distance design. Note over-all rugged construction.

WRITE FOR THE BOOKS YOU WANT. Booklet 2230-A on single-stage turbines; Booklet 2278 on coupled gears, and Folder 8603 on integral gears.

1. EQUIPMENT

A *complete* range of steam turbines for mechanical or generator drive, from 5 hp up . . . with a full line of reduction gears and auxiliary steam equipment.

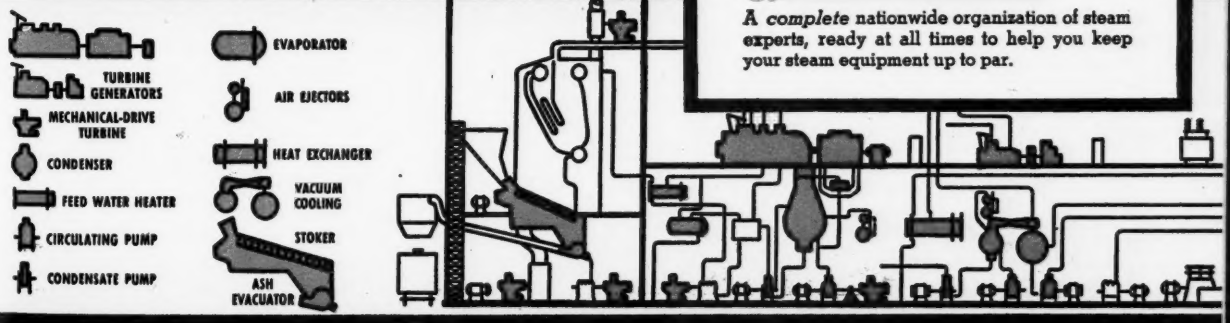
2. ENGINEERING

A *complete* and competent engineering service to help you select and apply the steam equipment best suited to your requirements.

3. MAINTENANCE

A *complete* nationwide organization of steam experts, ready at all times to help you keep your steam equipment up to par.

THE STEAM HEADQUARTERS LINE IS COMPLETE

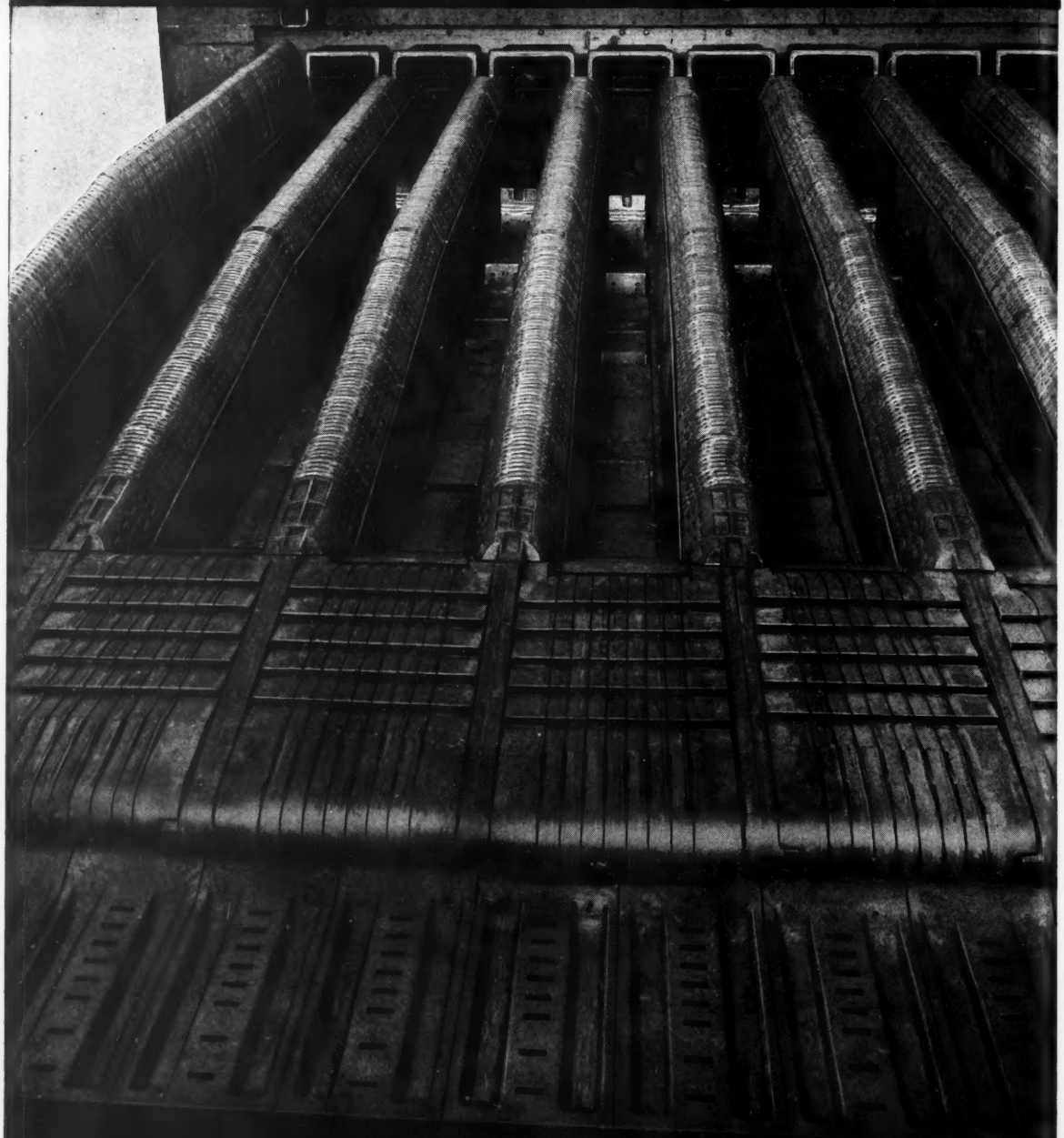


STEAM HEADQUARTERS

WESTINGHOUSE

Reduce Stoker

DETROIT MULTIPLE RETORT



DETROIT STOKER COMPANY General Motors Bldg. Detroit, Michigan

Absenteeism

STOKERS STAY ON THE JOB

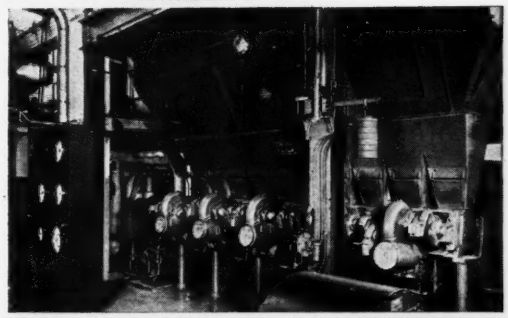
Detroit Multiple Retort Stoker

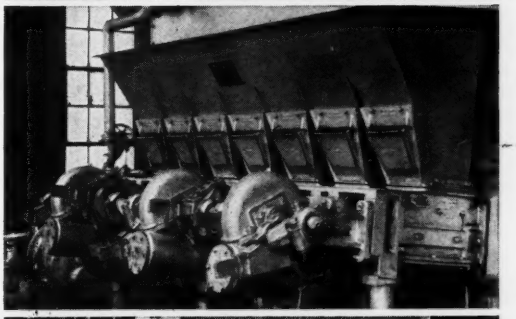
A stoker down for repairs is an ABSENTEE — and causes an ABSENTEE boiler.

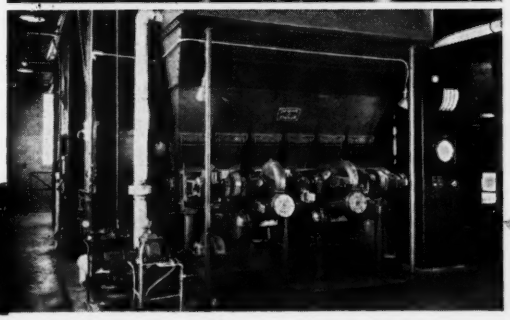
ABSENTEE equipment is a serious deterrent to war production.

Stoker ABSENTEEISM is negligible with Detroit Multiple Retort Stokers. Their great stability and endurance assure high availability.

Detroit Multiple Retort Stokers have made outstanding records in many plants. Write for Bulletin No. 124.





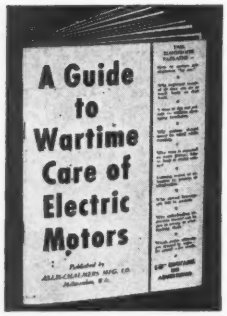


Works at Monroe, Michigan
District Offices in Principal Cities
Built in Canada at London, Ontario

FIRST AID FOR MOTORS

MOTORS RUN A FEVER? No wonder if they do more often today. They're working *3 and 4 times* as many hours as in peace!

Wartime conditions demand you diagnose motor ailments *quickly* . . . remedy the trouble at once. At right are but few of the many diagnoses found in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors". In maintenance as in war, *attack is the best defense*. This book singles out the 9 main enemies of electric motors . . . tells you how to get them *before* they get your motors!



Over 100,000 copies already in use.

Write today for your *free* copy. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

SYMPTOMS YOU CAN *SEE*

Symptom	Possible Causes	Cure
1. Excessive sparking or flashing at brushes. Blackened commutator.	Rough commutator.	Sand or turn down, depending upon depth of surface roughness.
	Low bar on commutator.	Grind or turn down balance of commutator.
	High bar on commutator.	If extreme, lower with mallet, tightening clamping ring. Grind true.
	Brushes too short.	Replace with harder grade—if worn too soon . . . and not by rough commutator.
	Shorted armature winding.	Test for short—after removing metallic contact between commutator bars. Repair.
2. Intermittent sparking at brushes.	Open armature winding.	Locate and replace bad coil—or repair defective joint.
3. Motor won't start.	Usually line trouble.	Correct. Check source of power supply.
	Load too heavy. See if motor runs without load.	Reduce load—or replace motor with unit of greater capacity.

SYMPTOMS YOU CAN *HEAR*

4. Excessive hum.	Uneven air gap. Measure with feelers.	Replace bearings—before introduction of scraping noise indicates rotor is rubbing.
	Unbalanced rotor. Check on parallel bars.	Balance with solder on band—or weight attached by cap screw and lock washer.
5. Regular clicking.	Matter in air gap.	Take out rotor; remove matter.
6. Rapid knocking	Misalignment.	Realign set until knocking disappears.
7. Brush "chatter."	Extreme vibration.	See item 10, below.

SYMPTOMS YOU CAN *FEEL*

8. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine.	Eliminate source in machine, if possible. Or a flexible belt drive may be in order.
9. Motor overheating. (Check with thermometer—don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with greater capacity unit.
	Dirt in motor. Check flow of air.	Blow out motor. Use solvent on wound section if necessary.
	Rotor rubs stator.	Replace bearings.

A 1638

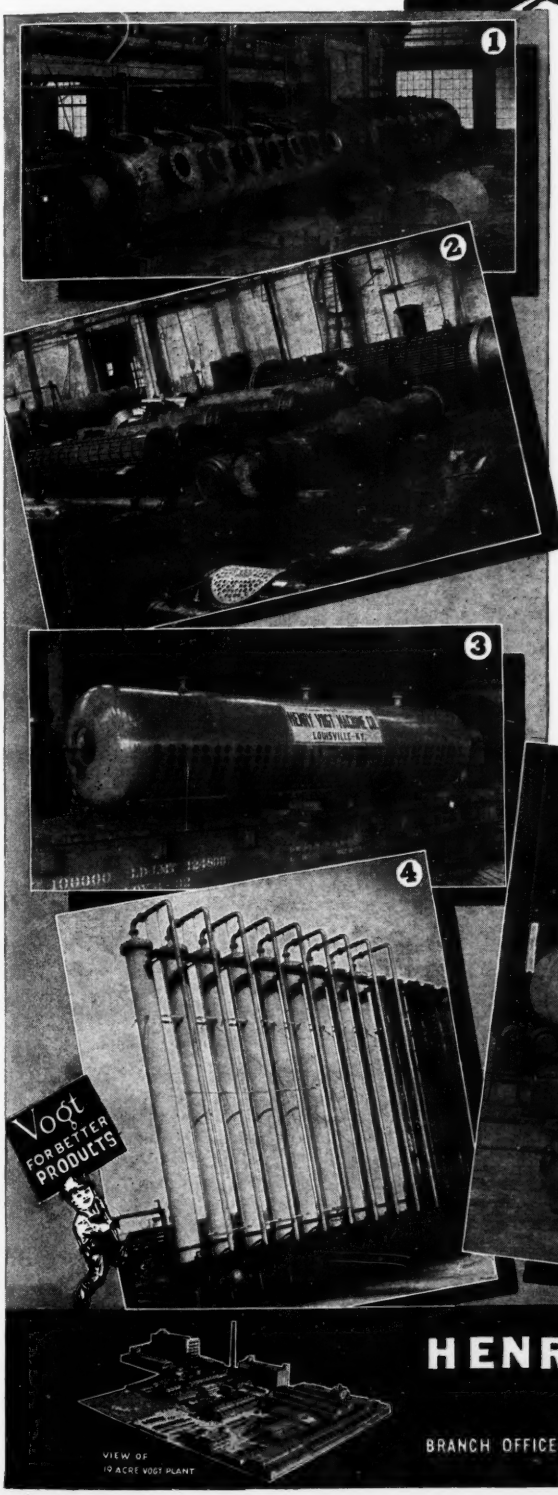
ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC WE WORK FOR VICTORY WE PLAN FOR PEACE

A.P.I.—A.S.M.E. and A.S.M.E. CODES • CARBON STEEL AND SPECIAL STEEL

WELDED PRODUCTS by Vogt



1 - 4′—0″ dia. x 7′—6″ dia. x 82′—5″ high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

2 - Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

3 - 48″ dia. x 22′—6″ long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

4 - Battery of Absorption Columns in a Western Refinery. Units are 33″ dia. x 41′—0″ high and were stress relieved after welding.

5 - 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.

VIEW OF
10 ACRE VOGT PLANT

HENRY VOGT MACHINE CO.
Incorporated
LOUISVILLE, KENTUCKY
BRANCH OFFICES: NEW YORK - PHILADELPHIA - CLEVELAND - CHICAGO - DALLAS

GET THAT UNIT BACK

WHEN condenser trouble makes shut-down of a vitally needed unit imminent and unavoidable—it's *a job for specialists.* Call Conseco, and schedule a rush job — between peaks if possible.

In a short time after actual shut-down, with our special hydro-dynamic shock test, we can tell you how many bad tubes you have. If the number is small, and plugging will get you by for a reasonable length of time, we'll give you the good news and have you back in service *pronto.*

If the percentage of weak tubes is seriously high, we'll tell you that, too, and give you a report on what has to be done, and how *fast* we can do it — and we mean *FAST.*

Where retubing is found to be necessary, we can usually complete the job in one off-peak down — because we are specialists and because we have the know-how, the facilities and often the materials.

For fifteen years, now, we have been servicing condensers and heat exchangers for utilities and industrial power plants throughout the nation. During this time we have developed our own time-saving tools and methods to give you a better, faster job. Today we are operating on a clock-around schedule — *Emergency Service* is our normal business. Don't hesitate to call us any hour of the day or night.

Condenser Service
AND ENGINEERING CO., INC.

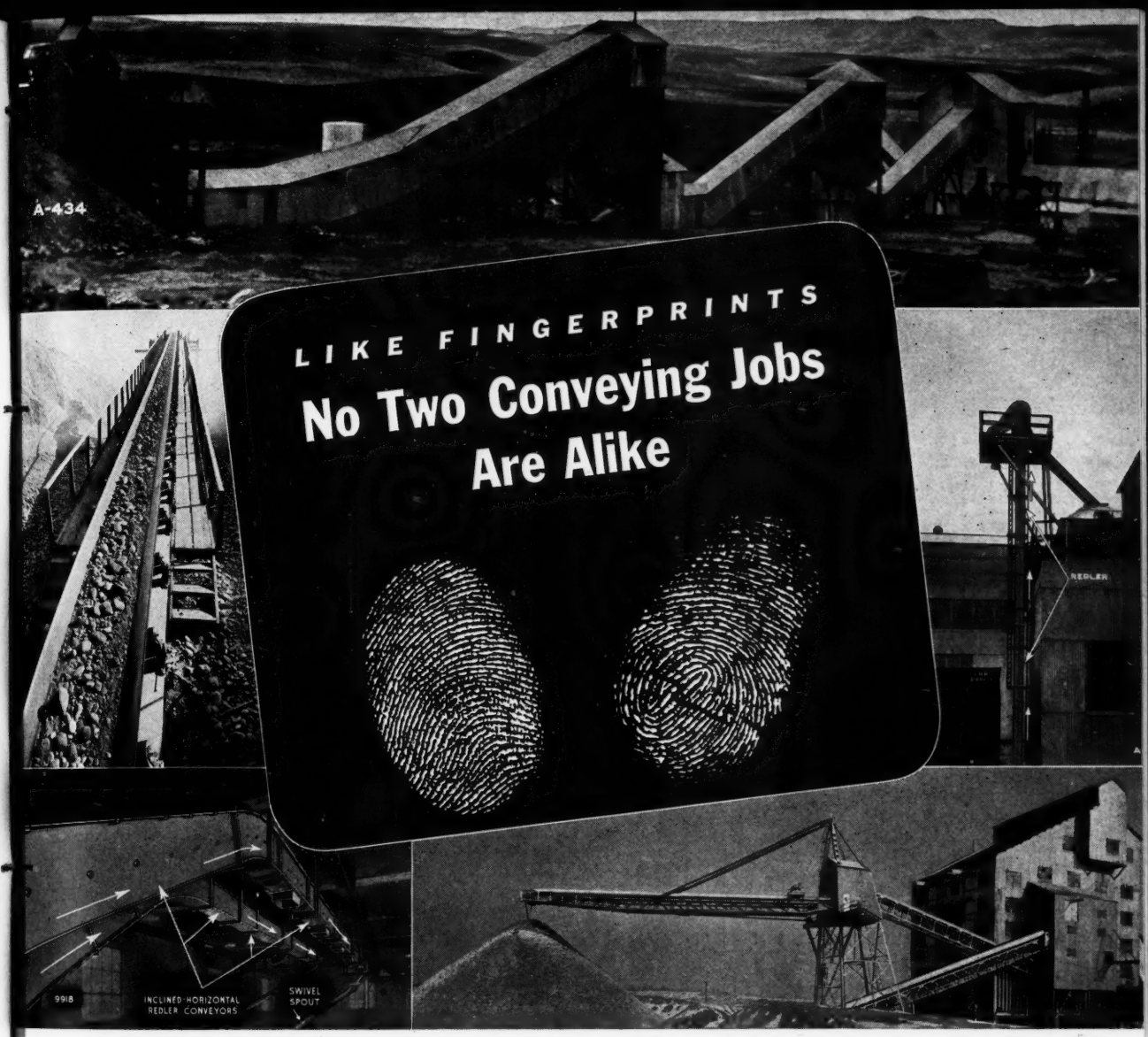
83 RIVER STREET, HOBOKEN, NEW JERSEY

★

NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

10-CS-1



Each Demands Competent, Experienced Engineering

● Every plant man knows that the efficiency of an industrial operation depends greatly on getting the right material at the right place at the right time.

But extreme variations occur in these three conditions—materials, place and time—not only from industry to industry but even within a single plant. Consequently, the engineering of successful material handling systems becomes a complex matter of matching the right type of conveying equipment and accessories to each specific job.

This is a highly specialized service, but one for which Stephens-Adamson engineers are fully qualified. For S-A designs and makes ALL kinds of conveying equipment. Whether a job calls for a belt, bucket or screw conveyor—or for a combination of these types—plus whatever accessories may be required—trust the S-A representative for an unbiased recommendation as to the exact system needed to move materials faster, safer and at lower cost.

If you face the problem of modernizing or expanding existing handling equipment to meet present production demands . . . or if you are concerned over new material handling problems that will come with post-war operations . . . have a talk with an S-A engineer now. Write us today.

STEPHENS-ADAMSON MFG. CO.
515 Ridgeway Avenue - Aurora, Illinois

STEPHEN S-A ADAMSON
MFG. CO.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

"FIRSTS" ARE A

"They laughed when we told them we'd run it with air."

... BUT TODAY 90% OF ALL NEW CONTROL SYSTEMS FOR BOILERS ARE AIR OPERATED

HABIT... *with Hagan!*

CREATIVE engineering, the knack of starting with little more than an idea—plus sound engineering practice, which takes hold of the device and makes it work—are an unbeatable team. The entire Hagan history proves this point. Its imposing record of "firsts" in boiler operating equipment is matched by an equally impressive story of performance.

Twenty-six years ago Hagan engineers started from scratch. They saw the growing insufficiency and waste in manual combustion control and resolved to correct it. The pioneering they did then revolutionized combustion control practice for all time. And from that day to this they have never ceased their research into boiler operating needs. One development after another has maintained this leadership.

You can see the effect in your own plant. And if you happen to be an "old timer" you may know how many of the improvements you value so highly today got their start on a Hagan drafting board. A number are mentioned here. Look them over.

This probably explains, better than anything else could, why you find Hagan Automatic Combustion Control and auxiliary equipment in so many of the finest power plants. It is also the best possible reason for learning more about what it could do for you. Write or call. We'll gladly send complete information on any one of these developments.

HAGAN FIRSTS

1. Hagan was first to recognize the need for incremental control—that is, a control that would operate in accord with the demand for steam rather than to shift from one extreme to the other, as had been the custom prior to our advent into the field.
2. Hagan was first to divide the load evenly and automatically among the boilers in service in a given plant.
3. Hagan developed the first control valve having independent adjustments for maximum and minimum . . . the roto-reciprocating valve.
4. Hagan was first to use compressed air in a combustion control system. Today 90% of all new control systems for boilers are air operated.
5. Hagan was first to develop control for gas-air proportioning.
6. Hagan was first to apply control to combination fired boilers.
7. Hagan was first to start and stop pulverized fuel burners automatically on combination fired boiler jobs.
8. Hagan was first to apply control to soaking pits, in the metallurgical field.
9. Hagan was first to apply control to hydraulic couplings in connection with complete boiler control.
10. Hagan was first to apply control to marine boilers.
11. Hagan was first to control pulverized fuel firing in metallurgical furnaces.
12. Hagan introduced the V-port butterfly valve, making possible accurate control in large lines, even at low flows.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

WHEN WATER TROUBLES GET YOU DOWN

—CALL THE ELGIN WATER CONDITIONING MAN

PEAK production schedules, shortage of skilled help and scarcity of equipment replacements, have imposed added worries on already overburdened plant engineers. But there's one worry you can escape. When water troubles get you down, call the Elgin Water Conditioning Man. He is an expert in handling water problems in your district and his services are yours for the asking.

As a pioneer in this field, our organization has had thirty-five years experience in solving water problems such as yours. Elgin products and methods cover every phase of water conditioning so that our recommendations are wholly unprejudiced—aimed solely at giving the results you want. We can prevent hard water troubles, scale formation, wet steam, corrosion, process steam contamination, and in fact, any of the troubles caused by improperly conditioned water. Elgin can take these problems off your hands and mind, for after all, water conditioning is our specialized business.

A COMPLETE LINE FROM WHICH TO CHOOSE

- Boiler Water Treating and Purifying Systems
- Feedwater Treatment
- Deconcentrators
- Heat Exchangers
- Water Softeners
- Filters and Purifiers
- Oil Removal Filters
- Iron Removal Equipment
- Aerators
- Water Treating Chemicals
- Chemical Feeders
- Scale and Corrosion Inhibitors
- Sample Coolers
- Water Testing Equipment
- Zeolites

Invest in America's Future Buy More War Savings Bonds

ELGIN SOFTENER CORPORATION
136 North Grove Avenue, Elgin, Illinois

ELGIN WATER CONDITIONING FOR EVERY NEED

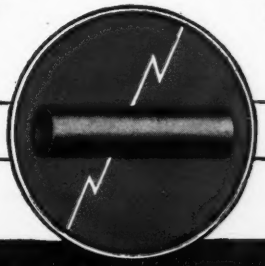
TALON'S
ELECTRIC WELDED STEEL TUBING

MEETS THESE SPECIFICATIONS

To meet the needs of industry for minimum weight and maximum strength, Talon's Electric Welded Steel Tubing is manufactured from flat-rolled strip steel and tested beyond the required limits of standard specifications. Each coil of strip must meet Talon's rigid requirements for accuracy to chemical and physical properties, gauge, width and finish. Safety, ease of fabrication, light weight, uniform wall thickness and diameter, and concentricity are thereby assured.

During and after the cold-forming operation, each length is subjected to critical inspection, and every foot of pressure tubing is hydrostatically tested. Grain structure of wall and weld is homogeneous—no extra metal is added in welding. Controlled atmospheric annealing improves physical properties and produces a scale-free finish. Talon's Electric Welded Steel Tubing in sizes from ⅝" to 4" O. D. is available for prompt delivery in lengths up to 40 feet.

PRESSURE



MECHANICAL

TALON . . INC.

STEEL TUBE DIVISION — OIL CITY, PENNA.

*SPECIFIC

TIDEWATER LUBRICANIA

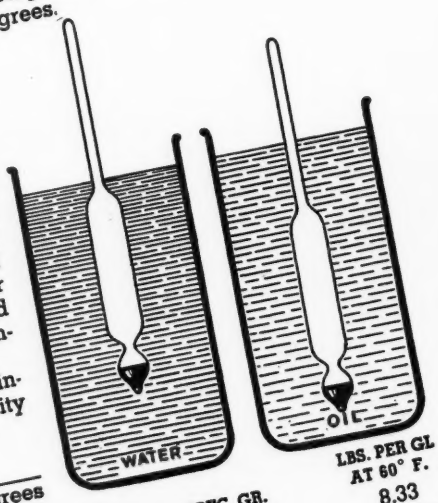
DEFINITION: The gravity or density of a liquid is a numerical value which enables the determination of the weight of a known volume of the product.

GRAVITY A. P. I. The gravity of petroleum products in the United States is generally obtained by means of a hydrometer graduated on the A.P.I. (American Petroleum Institute) scale. It is reported as Gravity in degrees A.P.I. Unless otherwise stated, it applies when the product is at a temperature of 60° F. If taken at a higher or lower temperature a correction is applied to reduce the reading to the standard 60° F. temperature.

The A.P.I. Gravity bears a definite relationship to specific gravity according to the formula:

$$\text{Sp. Gr.} = \frac{141.5}{131.5 + \text{A.P.I. degrees}}$$

The A.P.I. scale differs from the Baumé scale (used for non-petroleum liquids lighter than water) by only one-tenth to seven-tenths degrees.



EXAMPLES:	GRAVITY A.P.I.	SPEC. GR.	LBS. PER GL AT 60° F.
Water (distilled)	10°	1.00	8.33
Kerosene	36-40°	0.84-0.82	7.03-6.87
Machine Oil (paraffinic)	24-30°	0.91-0.88	7.58-7.30
Machine Oil (naphthenic)	18-22°	0.95-0.92	7.88-7.68

SIGNIFICANCE: Gravity is of little significance to the user. The quality or suitability of a lubricant is more readily appraised by other tests.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned immediately.

TYCOL lubricants are made from the most suitable materials and carefully refined to meet the most stringent laboratory specifications and service requirements. Scientific manufacture from the finest available material assures unvarying high quality in all Tycol lubricants.

TIDE WATER ASSOCIATED OIL COMPANY

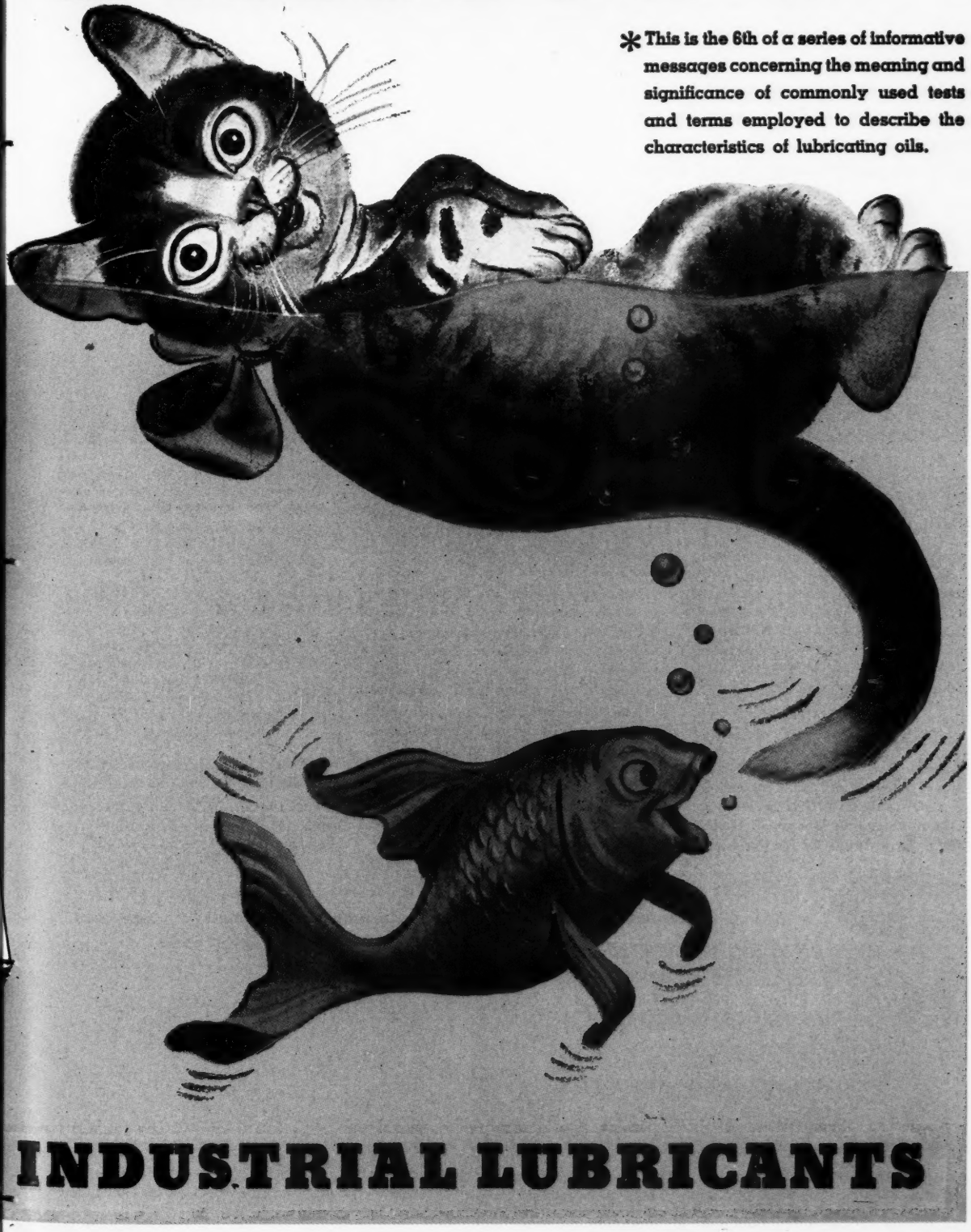
Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL

TYCOL

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

GRAVITY



* This is the 6th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

INDUSTRIAL LUBRICANTS

The First Line of Defense

No matter how badly the steel mills need scrap, a turbine or boiler will aid the war effort more by staying on the job than by going on the scrap pile.

Inactive equipment . . . equipment nearing condemnation . . . often can be made to serve you for many more months and years when protected — the quick, easy, low-cost way — with APEXIOR. And new equipment can be preserved at peak condition by this essential maintenance and operating material.

The Paint Takes the Wear

Hundreds of industrial power plants, utilities, railroads and marine operators have been using APEXIOR to lengthen the life of boiler or turbine metal. Applied with a hand brush or power-coater, APEXIOR seals up the pores and joints and provides a long-lasting, corrosion-resistant, scale-resistant covering for the metal. The APEXIOR takes the wear, not the metal — and one application lasts 2 to 3 years or more. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

APEXIOR is the safe, sure answer to lack of new equipment — the solution to your problem of getting more out of your present equipment. APEXIORIZE — you'll save valuable metal — and in the case of boilers, you'll lengthen periods between cleaning and make cleaning easier (with a wire brush).

Users like these have applied APEXIOR for years. It will help YOU get more service from irreplaceable equipment.

U. S. Army
U. S. Navy
U. S. Maritime Commission
U. S. Coast Guard
U. S. Bureau of Yards & Docks
U. S. Marine Corps
Cunard White Star, Ltd.
New York Central Railroad
Chicago & Northwestern Railroad
Georgia Power Co.
Duke Power Co.
Narragansett Electric Co.
Commonwealth Edison Co.

•

Ease of Applying APEXIOR Explained — Cleaning Simplified

Write, today, for Bulletin 1290 (Industrial) or 1305 (Marine) telling how to get peak production with peak protection.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park, Mass.

Please send me free Bulletin 1290 (industrial) .....
Bulletin 1305 (marine) .....

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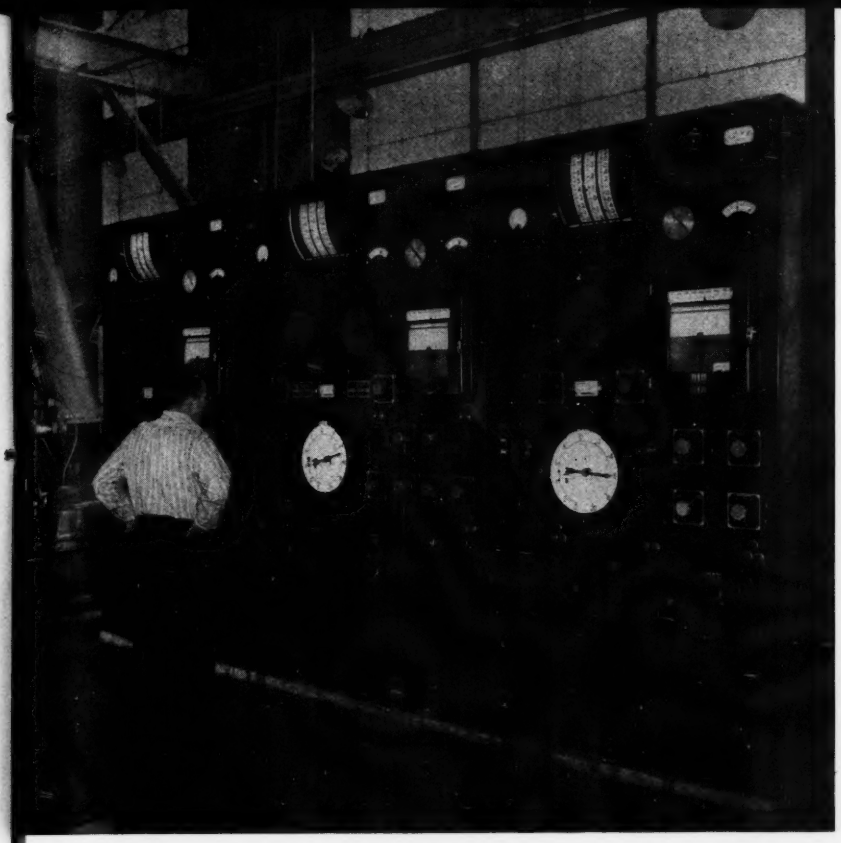
Main Office: **HYDE PARK • BOSTON • MASS.** • *Branch Offices:* **ATLANTA • CHICAGO • NEW YORK • DETROIT • PHILADELPHIA**

Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty Street, New York, N. Y.



Control panel for Henry Disston & Sons, Inc. new 200,000-lb/hr power plant. Included for the control of their three Riley steam-generators are Metermax Combustion Control, Micromax Temperature Recorder and Micromax CO_2 Recorder.

NEW DISSTON POWER PLANT
Instrumented Like a Central Station

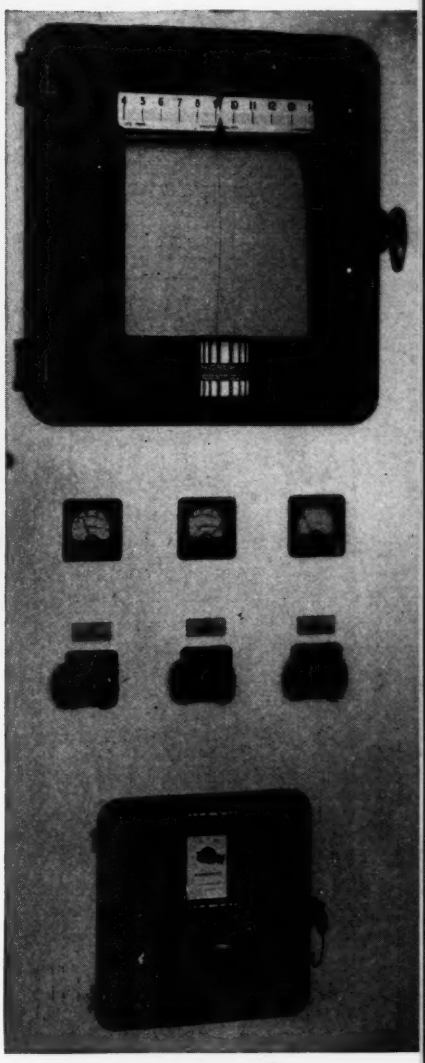
When the Disston engineers came to the point of specifying the control instruments for their new 3-boiler, 200,000-lb/hr power plant, they were in something of a quandary. Not for many years had the Company purchased combustion controllers, CO_2 recorders, or steam-temperature recorders; and, without some experience in such devices to guide them, the proper selection was a problem.

But, Disston had long been using temperature-controlling instruments, in the melting, rolling, hardening and tempering of the steel used in the manufacture of saws, files, knives, armor plate, etc. Many dozens of those instruments were L&N, and were giving extremely satisfactory service. Why not, then, reach over into the manufacturing department's experience, and specify L&N for the power plant?

Operations to date have amply justified the decision. The Metermax Combustion Control gives boiler operators a control distinguished for completeness and flexibility; a control which handles even the heaviest load swings with ease and smoothness . . . The Micromax temperature recorders supply multiple-point records of steam, water, flue gas and air, with the greatest dependability and with outstanding clearness and legibility . . . And the Micromax CO_2 Recorders are proving here, as they have proved in dozens of other plants, that CO_2 can now be recorded as easily, as accurately and with as little maintenance on the instrument as is the case with temperature.

All these instruments are described in well-illustrated catalogs; just send for the ones which interest you.

Jrl. Ad. N-163(10)



Catalog On Micromax Control Of Superheat

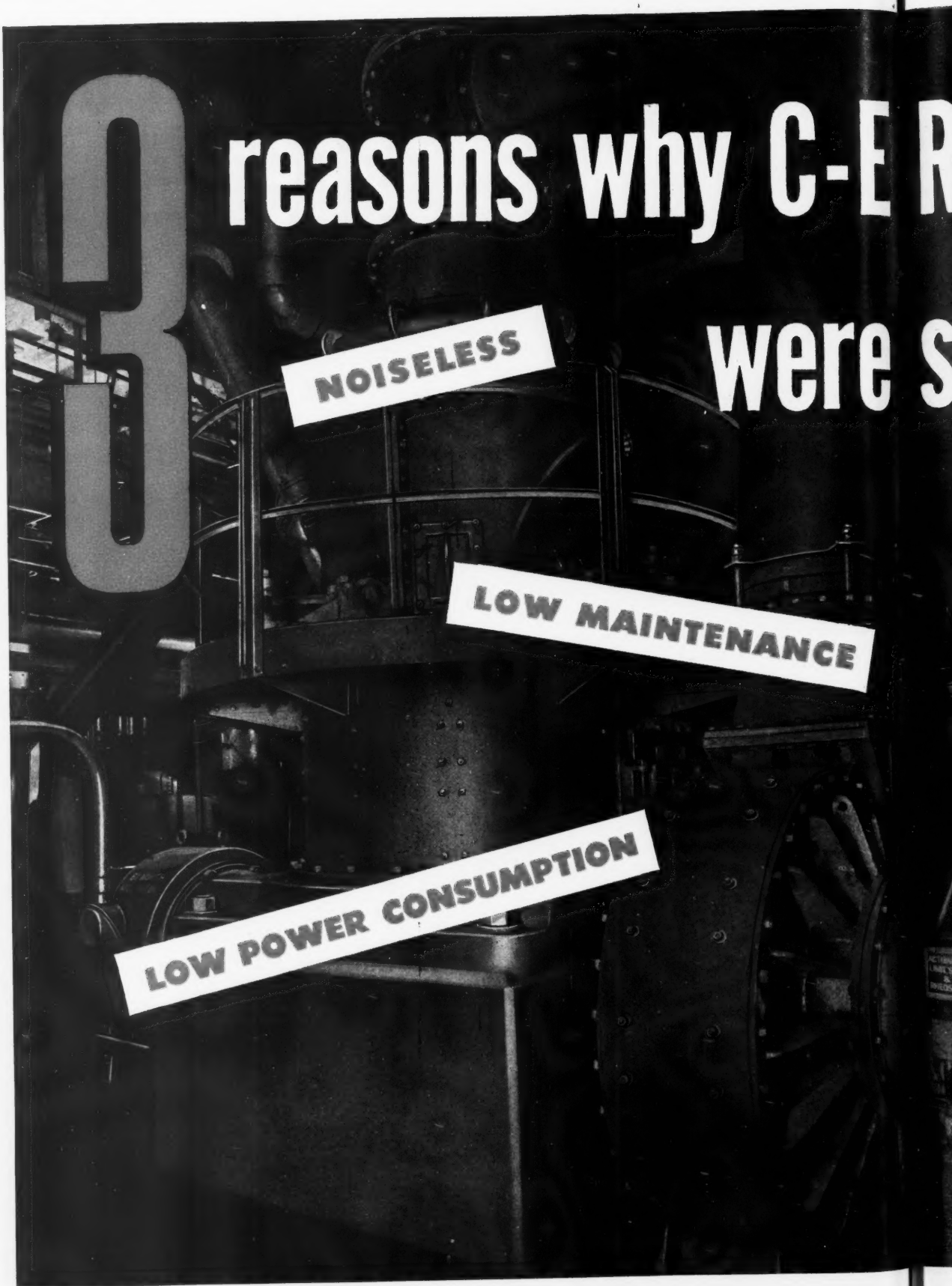
Micromax Superheat Control handles the damper just as a man would, if he had nothing else to do. That is, it moves the damper *in proportion* to each change in temperature. The Controller is seldom entirely still, but seldom moves abruptly or widely; temperature is held smoothly and constantly within the desired narrow band.

This method of control has been successfully used in various plants for some time, and the equipment is now catalogued in a compact, well-illustrated book. To receive a copy, ask for Catalog N-33-163(1).

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES


3 reasons why C-E R
were s
NOISELESS
LOW MAINTENANCE
LOW POWER CONSUMPTION

E Raymond Bowl Mills
e selected for more than

50%*

of all pulverizer capacity for boilers ordered since January 1st, 1942!

Certainly there are other reasons for the remarkable rise of the C-E Raymond Bowl Mill in a brief period of eight years to its present position of preference among power engineers.

Yet again and again we find many users of the Bowl Mill emphasizing its exceptionally quiet operation, its low maintenance costs and its high output per kw-hr. They seem to take for granted the ability of the mill to turn out the quantity and fineness of coal desired because with the Bowl Mill this becomes a matter of routine performance. But apparently they can never quite accustom themselves to the idea that a coal pulverizer can be as quiet as the Bowl Mill or cost so little to operate and maintain.

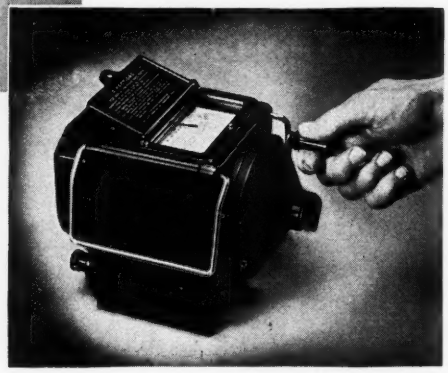
These three big advantages attested to as they are by such pronounced customer preference merit the consideration of every engineer who influences the selection of pulverizer equipment.

*Percentage based on capacity of pulverizers sold for direct firing of boilers for 16 month period ending May 1, 1943. Based on statistics of pulverizer sales as compiled by U. S. Government and American Boiler and Affiliated Industries. A-748

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK, N. Y.

ALWAYS
READY FOR USE



THE NEW "MEGGER" INSULATION TESTER . . .*

a worthy addition to the famous "MEGGER" family!

MADE IN U.S.A.

- HAND-CRANKED GENERATOR
- DIRECT-READING OHMMETER
- SIMPLE
- RUGGED
- RELIABLE

*Trade Mark Reg. U. S. Pat. Off.

With our Philadelphia factory now in full production, your needs for "Megger" Insulation Testers can soon be met.

Our new U. S. models are of the same general design and are similar in every way to our well-known "Meg" and "Super-Meg" Insulation Testers, except that they are housed in plastic molded cases instead of aluminum. All internal parts are made to the same proven design and specifications as the "Meg" instruments,—without compromise or substitution of materials. The cases are of high impact strength plastic,—one of the strongest, toughest molding materials available.

The entire instrument is built in our own plant by men and women who know how to make fine instruments. Our production is independent of the products of other instrument manufacturers.

We are fully confident that you will find these new Insulation Testers worthy members of the famous "Megger" family, and we invite your orders for them. At present we are offering ranges up to 100 and 1000 megohms with 500-volt generators. We continue to supply various other types and ratings of "Megger" instruments as formerly. Write for new descriptive Bulletin 1735-PE.

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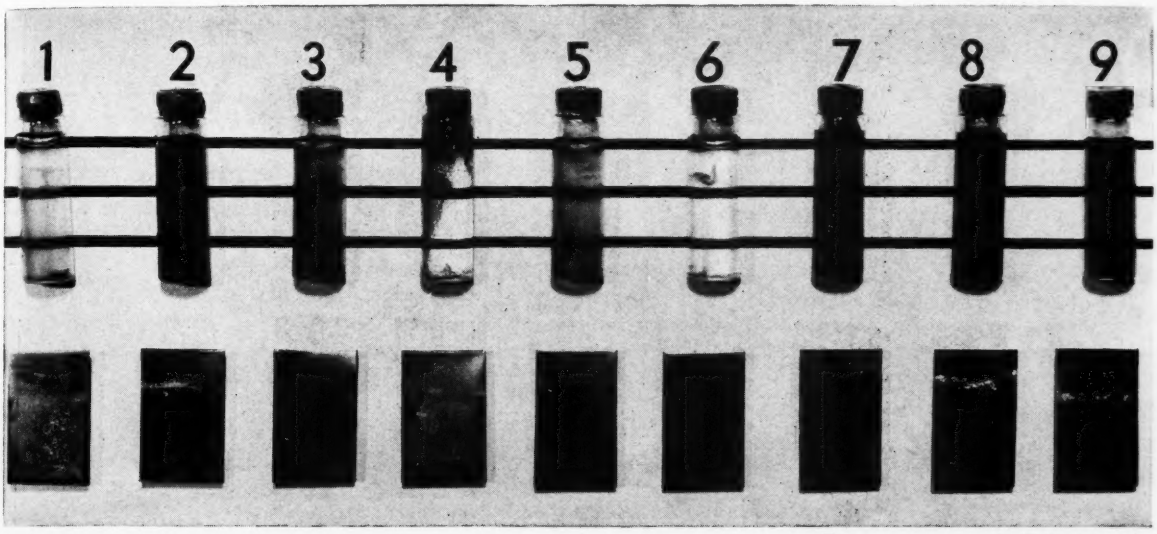
TEST RESULTS

ANTI-CORRODE vs. Competitive Products



From an unretouched photograph.

To substantiate our convictions that Anti-Corrode is an unexcelled rust-preventive, nine steel strips were cut from a sheet of No. 18 B. & S. deep drawing steel which had been thoroughly cleaned mechanically. One strip, number 6, was dipped in Cities Service Anti-Corrode. Seven others were treated with leading anti-rust compounds according to their manufacturers' directions. One strip, number 8, used as the control, was not treated.

All strips were then partly immersed in small bottles of distilled water containing 3% Sodium Chloride. At the end of 90 hours they appeared as displayed above. Each test strip is shown before its bottle of solution. The rust penetration on each strip is plainly evident. The background lines behind the bottles enable comparison of rust density found in the solutions after test. The superiority of Anti-Corrode—number 6—is obvious.

OUTSTANDING QUALITIES OF ANTI-CORRODE

Anti-Corrode is harmless to metal. It can be applied by brushing, spraying or dipping, and is a reliable safeguard against corrosion of metals in any form or state of finish, whether in storage or in transit. Anti-Corrode forms a tenacious, durable film that is impervious to moisture and the more common gases present in the atmosphere. Since it contains lubricating material, it need not be removed in drawing operations. It can be removed easily with kerosene or any petroleum solvent.

USERS' COMMENTS ON ANTI-CORRODE

"Our castings that have been properly dipped in Anti-Corrode show no signs of rusting after a month's exposure to rain and snow."

Assistant Plant Supt.
Large manufacturer of filters.

"We are pleased with the test results of Anti-Corrode on our rust problems and will place a substantial order with you shortly."

Manufacturer of special tools and accessories.

"$8,000 worth of dies were recently ruined by rust. This costly waste of vital materials is now being prevented with Anti-Corrode."

Manufacturer of ballistic dies.

"Condensation of moisture in storage vaults had been rusting our highly-precisioned tools and dies. Anti-Corrode has licked this problem."

Manufacturer of precision instruments.

Take advantage of the FREE demonstration offer. Send the coupon NOW! (Available only in the Cities Service marketing territory EAST of the Rockies.)

CITIES SERVICE OIL COMPANY
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I'd like to test Anti-Corrode on my own equipment FREE OF CHARGE. Please send me the details.

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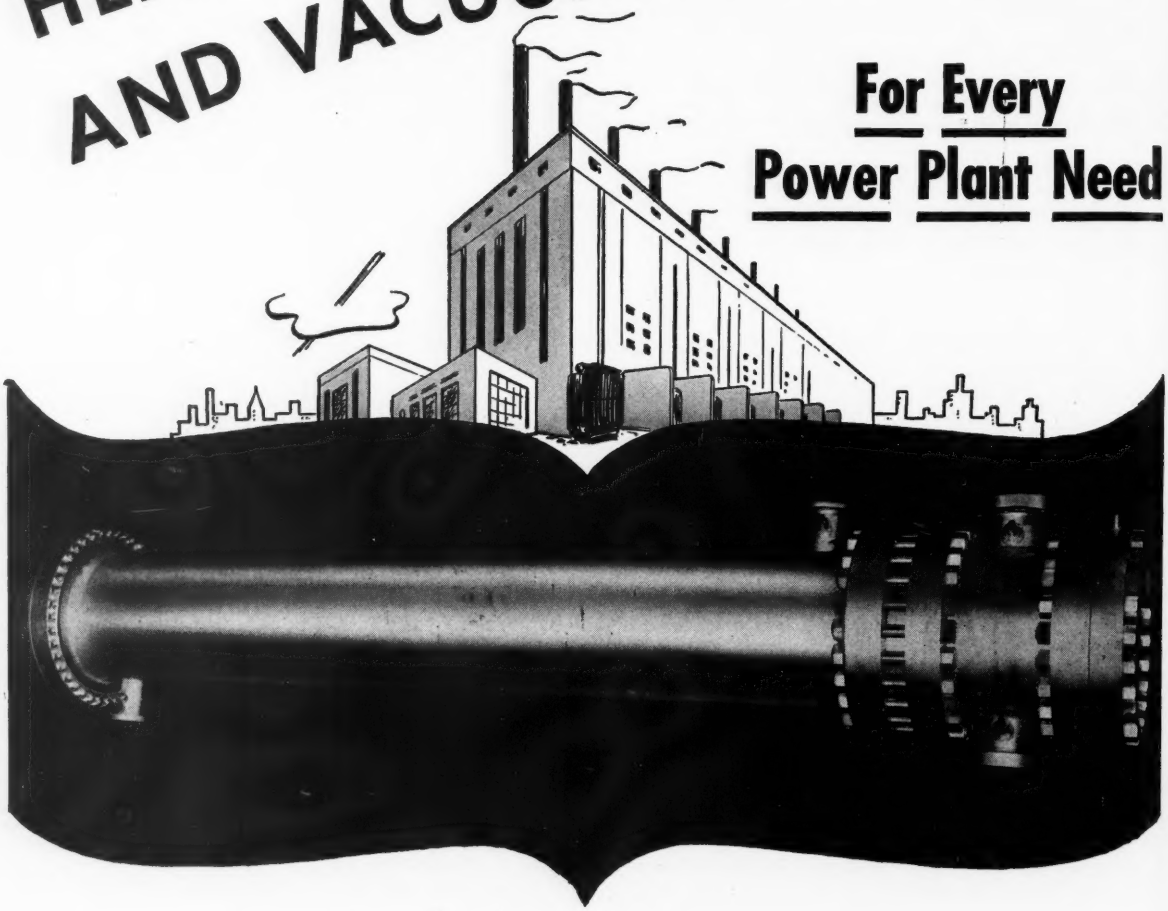
HEAT INTERCHANGE AND VACUUM EQUIPMENT

For Every Power Plant Need



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The services of Lummus engineering personnel are available to public utilities and industrial power plants for the study of specific problems and the design of heat exchange and vacuum equipment to meet individual conditions.

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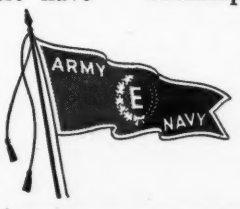
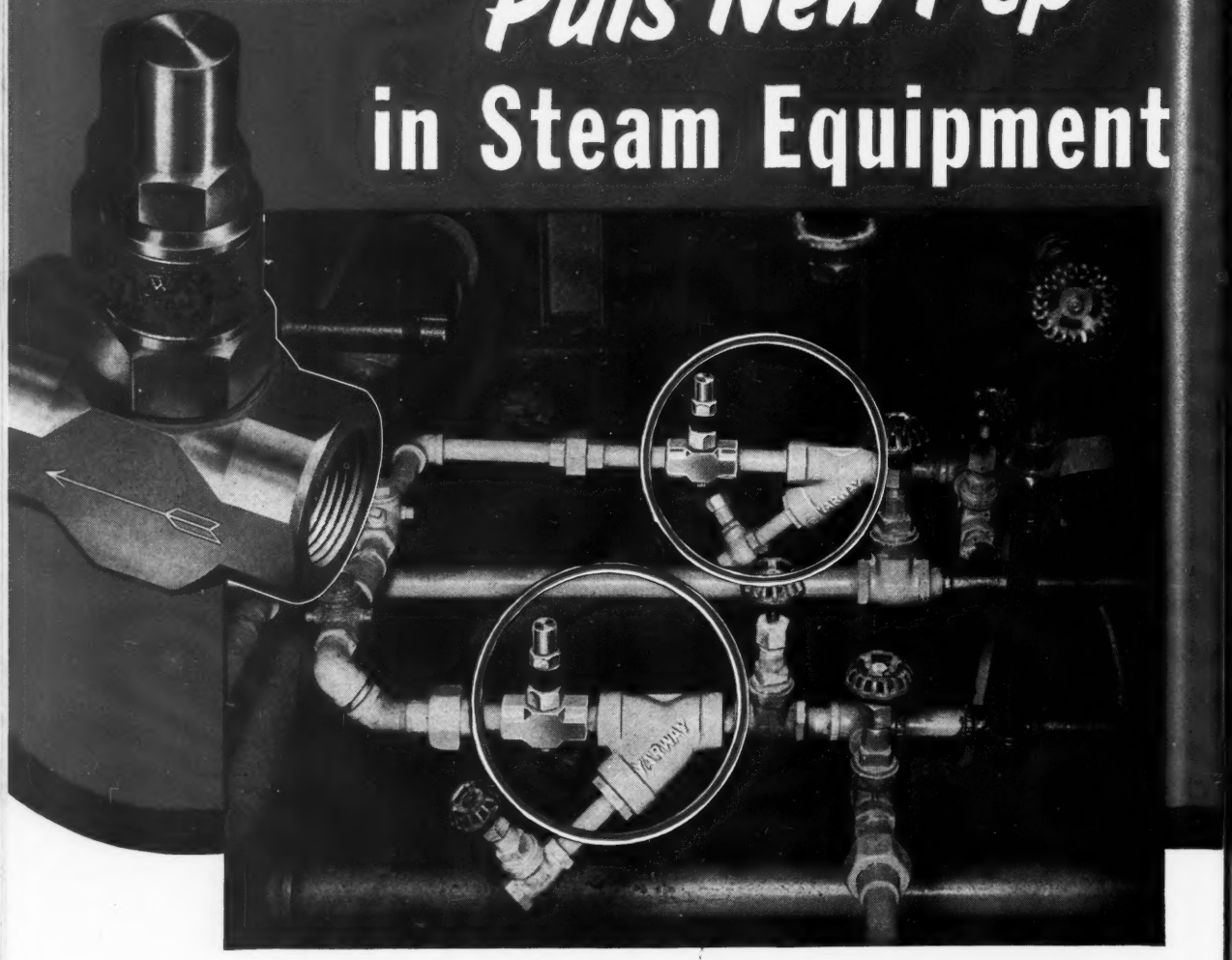
In this hour of history M-H/Brown engineers fittingly symbolize our faith in the future—that Electronic instrumentation (now at war) will blaze new trails in the manufacture of peacetime products. The Brown Instrument Company, 4491 Wayne Avenue, Philadelphia, Pennsylvania, a division of Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota. Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden.



Instruments by **BROWN** *and Controls by*

"Vitamin Y" Puts New Pep in Steam Equipment



PERHAPS you've never heard of Vitamin Y. For the sake of this message, it stands for Yarway Impulse Steam Traps. But you have heard of Gelatin Products Company of Detroit—world's largest producer of soft, elastic gelatin capsules, and big factor in the production of the health and energy-giving vitamins which hold the center of the stage in public interest today.

And here is the connection. A Yarway representative in this company's territory writes: "A year or so ago they started using Yarway Traps after they had been called to the attention of the Fine Chemical Div. Soon they were using them exclusively in this division and throughout the rest of the factory.

"They like them for their ability to work on any varying pressure, their freedom from air-binding and their compactness. Much of their equipment is small and the piping complicated. Yarways go in especially well.

"In all, they have over a 100 Yarways at work on heaters, stills, reaction kettles, unit heaters, etc.

"It would seem to me that we might play up the copy on the vitamin angle—vitamins to increase energy in the human body—Yarways always to increase the energy received from steam, etc., etc. With some thought we could make a catchy ad from this copy."

We think so too, but he could have mentioned that Yarway Impulse Traps usually cost no more to buy, than to repair an ordinary trap. Also that more than 250,000 have been purchased and over 100 convenient Mill Supply Distributors carry them. Why don't you see your supply house or write for Bulletin T-1737.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Two Post-War Fundamentals

By SIR NORMAN ANGELL

NO ONE who is old enough, as alas, I happen to be, to recall the reconstruction efforts made during the last war can forget with what optimism we approached that task of reconstruction and what great expectations we had formed of the outcome. You know, we know, the years of the depression have taught us, of the tragic anticlimax.

I suggest that if we are to avoid a similar tragedy of reconstruction going to pieces, we have to examine the nature of the mistakes we made, how our failure is explained. Because if we don't, we are quite capable of making the same or similar mistakes again, and failing again.

In the light of that experience I want to suggest that there are two mistakes we then made of which we have to be aware. The first was that we seemed all but completely to overlook the necessary political bases of economic reconstruction. By political bases I mean political order, peace, the absence of violence and war. It is no good having the most beautifully symmetrical plans of reconstruction, whether they are concerned with transportation, petroleum, mining, building, utilities, manufacturing, banking, investment, labor problems, if, just as they are beginning to work, the whole thing is thrown into the melting pot by some new war or indeed by the fear of war and the concentration of all effort upon meeting it.

The political principle which must constitute the foundation of economic reconstruction is not after all very complicated, however difficult its practical application may be at times. We must recognize that survival, self-preservation as nations, defense, is the first thing we have to insure. We now know—or ought to know—that that defense must be collective; based on *common* action against aggression, or it cannot exist at all.

It is precisely what has happened to the nations of continental Europe and would have happened to Britain if she had not changed her policy in time and recognized the profound truth, which lies at the basis of all peace, that if we are to defend ourselves we must be prepared on occasion to defend others. She decided in March, 1939, to undertake the defense of Poland. If she had adopted that principle twenty years earlier in the case of France, eight years earlier in the case of China, five years earlier in the case of Ethiopia, there would have been no second world war.

That, it seems to me, is the one lesson we have not yet perhaps sufficiently faced. It is the prerequisite for the success of the plans you have been elaborating. But there is another.

Economic Illiteracy a "Stumbling" Block

The final sanction for these plans of yours will be either legislative or a general acceptance by the people. The public, in other words, will in any case have the last word. But that public was revealed after the last war—let us be frank and honest about it—as cursed by quite incredible economic illiteracy. I have in mind such examples as the behavior of the British and French publics about reparations.

If only Britain and France had made up their minds to do in 1920, say, what they did twelve years later at Lausanne, much of the economic blizzard might have been avoided, possibly runaway inflation in Germany might have been escaped; in any case the problem would have been much easier, and if the inflation over central Europe had been avoided, we might never have heard of Adolph Hitler.

Why did the public take twelve years to make a decision which could have been made in one, or, for that matter, in twelve weeks?

I remember arguing this matter with some members of Parliament who later were my own colleagues when I sat in the House. They were demanding that Germany should pay astronomical sums and they attached a condition: Germany was not to increase her exports. They wanted money, not goods, no German competition in trade. I wanted to know what they meant by money. If we had been able to take, not merely the monetary gold in Germany, but every pair of earrings, we could only have collected about one per cent of what we were claiming. I asked my colleagues to assume that we had taken all the gold. How would they then propose to collect money while prohibiting any increase in German exports?

One of them, a very popular and influential figure, nevertheless insisted that, if the Government had sufficient intestinal fortitude, it could collect the money. He had a plan. He would go to Berlin with a regiment or two and notify the German Government that unless certain trucks he had ready were loaded up with the money they owed us within two weeks, twenty per cent of the German cabinet would be executed. If then the money was not available, another twenty per cent would be executed. It would, he said, secure the money.

I asked him to imagine that his plan had succeeded and that he had brought this money to London and Paris. What would he do with it there? The butcher and baker would not take German marks. Nor would the income-tax collector. That money had value in one place in the world only, in Germany, where truly it could be exchanged for goods. But my friends had imposed a condition. Those goods must not leave Germany—German exports were not to be permitted. What, therefore, I asked, would the plan amount to?

Is that difficult to see? It took our people twelve years to see it. I don't think the French ever saw it. And possibly certain senators and newspaper proprietors have taken secret oaths that in respect of the British debts they never shall see it.

Is not this something of a reflection upon an education that is presumed to prepare us for democracy, for giving into the hands of millions the final word on these policies, economic, financial, monetary, which we have been discussing?

I doubt very much, taking the example of economic illiteracy I have selected, whether the mass of voters are prepared to accept the proposition that, if we will not buy the goods and services of others, it is an economic impossibility for those others to buy our goods and services. Both propositions are mere truisms, undeniable. They should be self-evident. But even today in our democracies, political and economic illiteracy is such that both propositions are widely, angrily, passionately denied. While this remains true, no stable reconstruction is possible.

Sir Norman Angell, member of the British Labor Party and recipient of the Nobel Peace Prize in 1933, has studied for many years the relations between political and economic factors and the maintenance of peace. Before the first World War he was a newspaper editor in Great Britain, later in France and he has served as correspondent for a number of American newspapers. He has also been editor of the magazine, Foreign Affairs, a member of the British Parliament and has written many books on international relations, The Great Illusion being probably his best known book in this country. The foregoing comments are from an address last May before the National Industrial Conference Board.

BUT NO MEAT BALLS

Probably, they could not get them anyway but it so happens that Westinghouse does not use meat balls with its spaghetti. Before jumping at conclusions permit us to inform you that the spaghetti is used in the electronics division, not in the restaurants. It is real spaghetti, however, uncooked but otherwise the same spaghetti you eat and strangely enough, it has been put to work in the manufacture of electron tubes. With their eyes still wide in amazement, veteran production men at the Westinghouse Lamp Division recently told how William A. Hayes, a young electronics engineer discovered this novel substitute that cuts by 75 per cent the time required to assemble certain tube filaments. A stick of spaghetti placed inside a tiny wire coil supports the coil while it is being welded. Formerly, a piece of steel was used as the support but it was difficult to remove and often the coil had to be realigned. The whole job was troublesome and time-consuming and so Mr. Hayes was assigned the task of breaking the bottleneck. After trying everything else, Mr. Hayes tried spaghetti. Now a little stick of spaghetti is inserted where the steel pieces used to go. After the filament is welded, electric current is passed through the coil to remove any impurities in the metal and this burns up the spaghetti in a flash; it disappears completely. The assembly formerly required about 5 min; now, by using spaghetti, the job is done in a trifle over a minute. Of course, all this did not take place all at once. First, Mr. Hayes visited the spaghetti manufacturer and found out how accurately spaghetti could be made with regard to exact size. He found that it can be made with fair precision and that it can be machined on a lathe. For the first experiments, a stick of spaghetti was placed on a lathe and machined to the correct diameter. This was probably the first time in the history of man that spaghetti was machined on a lathe. Now, as a result of Westinghouse's interest, the spaghetti maker uses a die to enable him to produce sticks to the correct diameter for the tube operation.

WITH THE EDITORS

◆ **HOME-FRONT SERVICES**—Designers and constructors have supplied the means by which the heat units lying dormant in fuels can be activated and put to the work industry requires to be done. Just how well that conversion is done depends upon how well each individual in the plant performs his share of the work demanded by the organization. Each water tender, fireman, oiler, engineer, electrician, repairman—all must do their parts in the process of power generation, each with confidence that the others' responsibilities will be carefully met so that when a starting switch in some distant industrial plant is closed every piece of equipment clear back to the coal pile will respond instantly to the demand with high quality service.

The nation at war worries us more than we realize. We are all keyed to thoughts of how we can help bring the conflict to a close quickly. Each of us has individual problems that prevent us from doing everything we think we should do and nearly everybody is confused regarding his patriotic duty in this conflict which is not confined to the battle fronts but influences directly our every day home life.

◆ **PROFESSIONS, VOCATIONS, TRADES**—Civilized society long ago learned that a more plentiful supply of needed materials can be produced when the work of preparation is divided up and assigned to individuals whose talents and abilities fit them to carry out the specialized services assigned to them. This organizing of human work, both physical and mental, has complicated social conditions to such an extent that no individual can expect to maintain his living conditions independently but must depend upon the work and cooperation of others to supply his wants.

Due to this specialization of human services, which has been gradually increasing through the years, the average standard of living has advanced greatly. In America today, practically every normal human being enjoys conditions known to but a very small percentage of the people of past generations. The drudgery of heavy work in homes, factories and on farms has been vastly relieved by labor saving machinery. The comfort and health conditions everywhere have been vastly improved which has raised the average span of life from 48 years in 1901 to 63 years in 1940. Educational advantages are open to everybody. At no time in history has the average person been given the opportunity to travel that Americans have enjoyed during the past 20 years. The cost of food, housing and clothing, the three essentials of life, varies between 50 and 70 per cent of the average family income, leaving 30 or more per cent for savings and the enjoyment of higher living. All this has come about through the efforts of individuals who have mastered their work and used their talents to supply the needs of society. The nation needs just this type of service during the present crisis—everybody doing his very best in work for which he is best fitted.

◆ **CRITICAL MATERIALS**—It is inevitable that shortages will occur among the many commodities used in our daily living. War has shut off our normal supply of many of these commodities. To continue using rubber, for instance, the country must develop a domestic supply or manufacture synthetic types which will serve in place of natural rubber. Another alternative is the use of substitute materials, different kinds for different services. While new sources are being developed and the products are coming on the market, it is folly to expect that usual quantities can be supplied, that equipment designs using this new material will meet former standards of performance or that former prices can be maintained. With the demands for war materials coming first, users of critical materials will be helping if they cooperate in the pioneer work of developing substitute materials.

By the process of specializing attention on the need for critical materials, the War Production Board has been able to increase the production of a number of the most needed materials to a point where the supply is meeting the war demand and providing a limited amount for civilian use. The Board lists some 500 materials as essential to the war program. These lists are arranged in the order of their relative availability and in this way help users to make selections of substitute materials from among those whose supply is sufficient or at least not so critical as the material being used.

Month by month these lists have been available to users of materials with the result that one at a time critical materials have become less critical. The production of aluminum, for example, has been vastly increased during the past two years through the construction of immense plants in sections of the country where electric power is available, bringing this metal, at the present time, one step away from the most critical position.

By like planning, the rubber situation is beginning to ease. While chlorinated, crude, latex and synthetic rubber are in the most critical column, reclaimed and scrap rubber have moved away from that classification. Copper, tin, zinc, and their alloys are still far below needs in production. A similar position is held by stainless steels, those containing chromium and nickel, but other alloys such as SAE, NE, tool steel and carbon steel are not among the most critical. Here again in supplying critical war materials we find best results have been secured by directing special efforts toward bringing up production of specific materials. The battle of materials against the critical shortages that developed when Japan struck at Pearl Harbor is definitely being won by American technologists in the fields of mining, metallurgy, agriculture, engineering and chemistry who have been able to gear industry for all-out war production and supply the raw materials.

◆ **FUELS**—The winter ahead is not going to be without its fuel problems but many who were inconvenienced last winter have learned their lesson and have converted their plants so they will be able to use the fuels that are more than likely to be available to them. In spite of the labor difficulties encountered in the coal mines, the production of coal during the first nine months of 1943 is slightly above that of 1942 for the same period, as are the stocks held in storage by the principal industrial users. With greater production of war materials now going on than was in progress last year, the need for fuel is greater and every effort should be made not only to produce but to store fuel at the point of use to the extent of having 60 to 100 days' supply always immediately available.

Fuel shortages through the eastern section of the country last winter caused much discomfort among dwellers in houses and apartment buildings. Continuous efforts throughout the year have been made to relieve that situation this coming winter. The oil supply will undoubtedly be better with the Big Inch pipe line delivering crude oil from the Southwest to the eastern refineries and the submarine menace under better control.

Too much dependency should not be placed on securing an abundant fuel supply for the margin of difference from last winter will not be great and there will still be those who will need to resort to electric heaters, gas ovens, gas stove burners, and hot water in bath tubs and wash tubs as they did last year. Many, however, found their best answer to the problem in warmer clothing that will permit comfort in rooms held at temperatures around 60 F. Insulating all houses and weatherstripping windows would save millions of tons of coal, according to heating authorities.

Right now the greatest need of the country is for workers in industries essential to the prosecution of the war. The Office of War Information states that 2,600,000 men and women workers are needed for home-front work. The suggestion is made that some of these may come from artistic, musical, sports and similar fields. So urgent is this need for war workers that the advisability of enacting legislation which would permit drafting workers for essential industries is being considered by Congress.

In this connection it is to be hoped that extreme care will be exercised not to deplete the operating staffs of industries to the extent that the safety of employees or the public will be jeopardized by compelling the employment of incompetent maintenance men. Many of the older industrial plants of the country are operating machinery that under normal conditions would be discarded because of its worn out condition, yet due to the urgent need for the equipment and the impossibility of replacing it with new units, the maintenance men keep it patched up and going on pounding out its product as best it can. Such operation requires extreme skill and offers dangers little appreciated by the uninitiated.

In this war campaign on the home front, no power engineer need question the need for his services, for power is recognized as one of the essentials of industries engaged in war work and to have a necessary part in its production is performing a patriotic service.

The

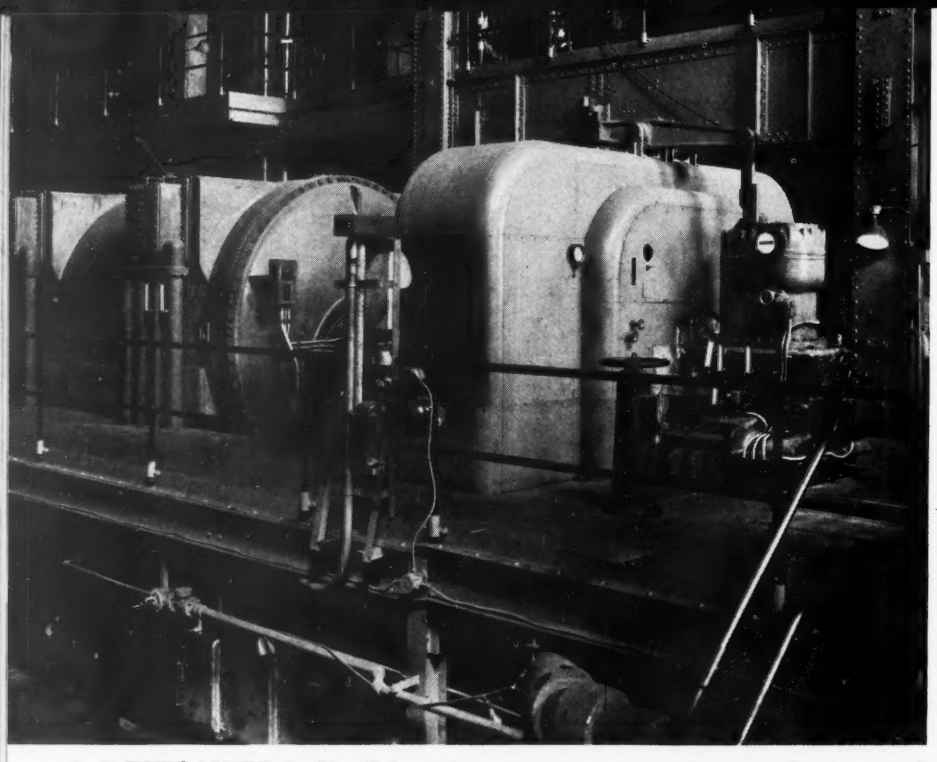


Fig. 1. A turbine-end view of the new 50,000 kw, 1600 psi turbine generating unit at Sherman Creek. It consists of a single cylinder impulse stage followed by 16 reaction stages. The generator is hydrogen cooled with integral fans and internal gas coolers

AS EXPLAINED in Mr. Robert's article on the boiler installation, the ultimate program at Sherman Creek Station calls for four high pressure boilers, each to serve a 50,000 kw topping turbine. The initial installation consists of the 1,000,000 lb per hr boiler described in the previous article and one 1600 psi, 950 F, 50,000 kw noncondensing turbine. The low pressure house contains 8 turbine generators with a combined capacity of 105,000 kw. Under normal conditions, the 200 psi, 485 F, exhaust steam from the high pressure turbine will be sufficient to operate 50,000 kw of low pressure turbine capacity and to drive the high pressure auxiliaries. The expected heat balance is shown in Fig. 4 and the general layout of connections in Fig. 3.

General

This installation incorporates several features of special interest. The turbine is the largest unit of its type considering its rating, pressure and temperature. The boiler feeds steam to the turbine through a single 12 in. lead in which the usual costly gate valve has been omitted. The vertical expansion in the steam lead, which rises about 60 ft from the turbine stop valve to the superheater header, is directed upwards from an anchor at the turbine. This expansion is taken up in the long, horizontal, flexible superheater tubes that tie into the spring supported superheater header. The calculations for stress, due to expansion in the high pressure steam, exhaust and extraction lines, were checked by the use of scale model tests.

The control of feed water to the boiler is handled by a 3 element system, in which water flow, steam flow and drum level changes combine to vary the speed of the boiler feed pump turbines. The usual boiler feed control valve has been omitted saving cost and feed pump horsepower.

In operation it was found possible to run the turbine exhausting into the 200 lb station header as soon as a pressure of 400 lb was obtained in the high pressure boiler. Starting time is therefore considerably less than that required on similar turbines on the system. Since the gland steam leak-off is tied into the sub-atmospheric direct-contact heater as soon as possible after starting, the only steam lost to atmosphere is a relatively small amount blowing through the casing drains on the turbine. These are closed as soon as the machine operates against 200 lb back pressure. A relatively short turbine foundation, built of concrete, has reduced the effect of vibration considerably.

The generator design incorporates a "flexibly" supported armature core to minimize double frequency vibration. This is accomplished by suspending the armature core in such a way that the core can move radially with considerable freedom but is rigid in the direction of torque load.

Following the policy used in our previous topping installations, all the piping has been generally laid out in a simplified and streamlined manner eliminating costly bypasses, extra valves and cross-connections. This has been accomplished, to a great degree, by the grouping together of equipment tied together with piping.

To eliminate glare and improve its appearance, the turbine gage board is equipped with integral indirect lighting. The fluorescent tubes are mounted at points on the back of the false front panels, hinged for access to the instruments.

The completion and placing into satisfactory operation of this unit under difficult wartime conditions, was made possible by cooperation of the Edison Company's Construction and Shops Department with the manufacturer. Although all of the material for the turbo-generator was complete at the manufacturer's plant, our shops machined the turbine spindle and fabricated the main oil reservoir, oil piping, governor linkage and other miscellaneous parts. In addition, the turbine was first assembled and fitted on the foundation and the preliminary run and adjustments performed in the field. This departure from the usual assembly and test at the manufacturer's shop worked out very satisfactorily.

Turbine Generator

The turbine-generator unit, manufactured by the Westinghouse Electric & Mfg. Co. is rated at

Topping Program At SHERMAN CREEK

Part II

In the September issue, in an article by R. J. Roberts, Assistant Division Engineer of the Consolidated Edison Co. of New York, we presented a detailed description of the new million pound per hour boiler in the initial development of the topping program at Sherman Creek Station in New York. Now, in this article by H. Knecht, the Division Engineer of the company we present the details of the 50,000 kw, 1600 psi turbine generator which represents the other half of the initial topping program. This turbine is the largest unit of its type, considering its rating, pressure and temperature, ever installed. Heat balance and connection diagrams are shown. A final article, describing the condensate system and boiler feed pump control, will appear next month.

By H. Knecht ***Division Engineer,***

Consolidated Edison Company of New York, Inc.

50,000 kw at 0.8 power factor, 13,800 v, 60 cycle, 3 phase and operates at 3600 rpm. The design conditions are 1600 psi, 950 F, at throttle, 400 psi at bleed point and 200 psi, 485 F at the exhaust.

As indicated in the cross-section Fig. 2 the turbine is a single cylinder impulse stage followed by 16 reaction stages. The reaction stages are designed with constant diameter at mean-blade heights to obtain practically constant net axial unbalanced steam thrust and thrust bearing load.

Six control valves are provided, five admitting steam to different sections of the impulse stage nozzles, the sixth or overload valve admitting steam to the eighth stage. This internal by-pass valve is under the control of the governor and opens only when the normal capacity of 50,000 kw handled by the first five valves is insufficient. The maximum overload capacity of the machine is 56,250 kw. The steam chest which carries the 6 admission valves is cast integrally with the cylinder cover thus eliminating a high pressure steam joint.

One of the design features is an annular steam belt extending around the entire cylinder at the inlet end. This chamber serves as the passage between No. 1 valve located in cylinder cover and its nozzle located in the base. It therefore is filled with high temperature steam as soon as the first valve opens and helps to reduce distortion of the casing during warming and starting up. For simplification of the cylinder castings the lower half nozzle chamber has been made a separate casting supported in the cylinder much the same as the separate reaction blade rings.

The cylinder is mounted on pedestals designed to provide approximate center line support. The turbine is free to expand in all directions from the anchor at the exhaust connections and longitudinal keys are provided to maintain alignment with the generator. The pedestal between the turbine and generator is stationary, while that on the governor end is of the lubricated sliding foot type.

The governing system is the full hydraulic oil actuated type similar in design to that used on the other Westinghouse topping units on the system. In addition to the speed responsive and emergency tripping elements, a 200 lb back pressure control is provided on the main turbine exhaust to limit back pressure to a predetermined maximum in the event of disturbing conditions in the low pressure steam system. Control of back pressure is normally handled by the high board operator who regulates load on the low pressure turbines to maintain approximately 200 lb in the low pressure steam system. An unusual rise in back pressure actuates the back pressure control which in turn closes the admission valves.

For suitable protection and supervisory control the turbine is

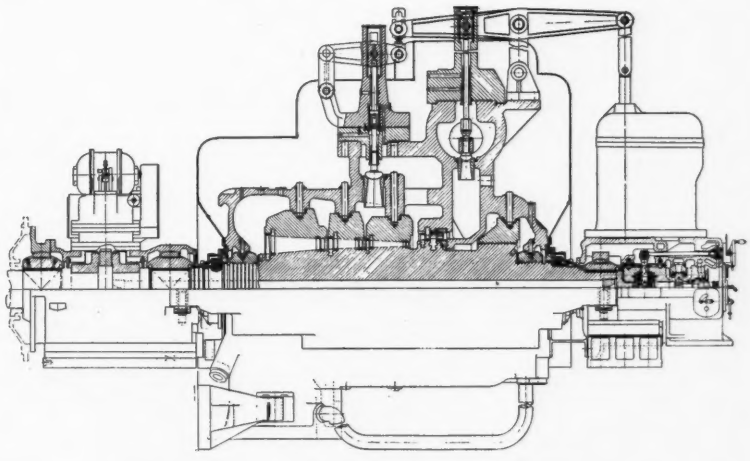


Fig. 2. A cross section of the high pressure turbine

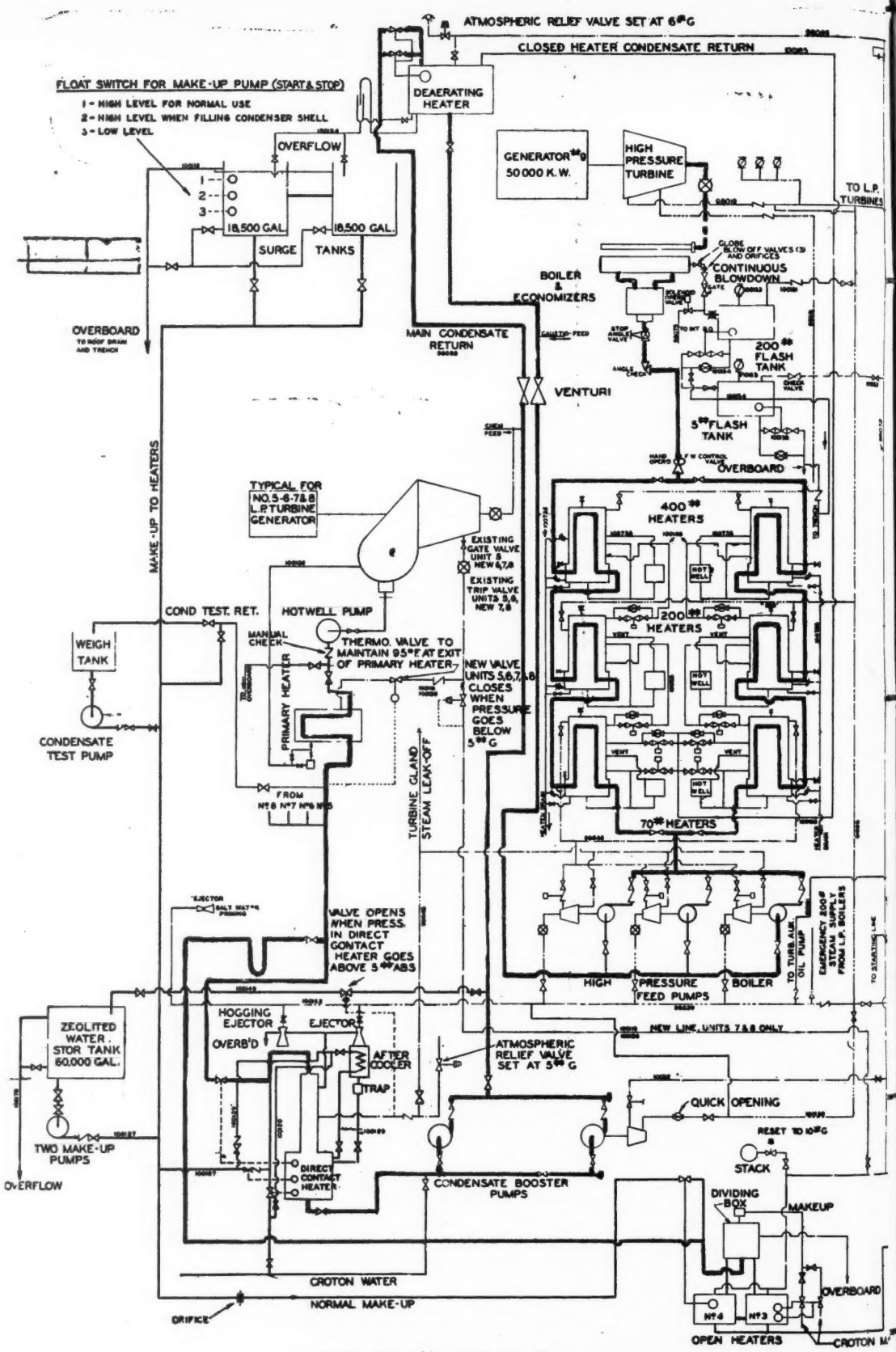
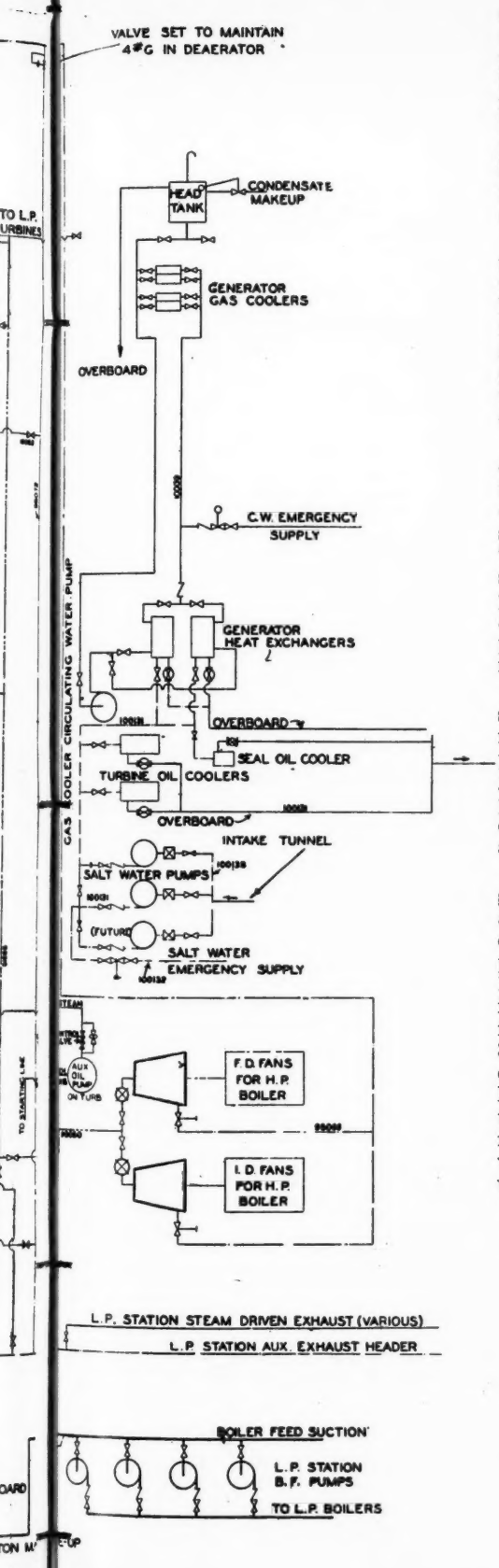


Fig. 3. General layout of connections



equipped with several devices. A watt type reverse power relay is provided, designed to give an alarm in case motoring occurs. This might cause overheating of turbine blades. In accordance with our practice, the high board operator is instructed to remove this unit from the line when the load has dropped to 2000 kw.

Opening of the control valves may be limited by manual operation of a load limit valve. Such limitation of load may be desirable if either turbine or boiler capacity is below normal, in which case the generator should not be free to pick up load in event of a sudden decrease in system frequency.

A turbine shaft position indicator and recorder is installed to indicate the relative axial position of the rotor thrust runner with respect to the thrust bearing support. This device gives the operator instantaneous readings of the rotor position at all times and sounds an alarm if the rotor moves beyond a predetermined distance, such as might occur from abnormal thrust.

A vibration meter has been installed to detect and record both normal and unusual vibration amplitudes occurring at points adjacent to the bearings. This apparatus consists of shaft pick-up to detect vibration, an amplifier and a recorder.

The generator is of the hydrogen cooled type with integral fans and internal gas coolers. It is capable of delivering rated kva output at all terminal voltages from 13,200 to 14,500 v. With air cooling instead of hydrogen the capacity of the generator is limited to 35,000 kva. Approximately 50,000 cfm of gas are required for ventilation. Normal rise in the armature at full rating is 60 C, in the field 85 C. The generator housing will withstand a pressure of 100 psi without failure. This exceeds the pressure which would result from an explosion of the enclosed hydrogen.

Excitation is provided by a direct connected exciter and pilot exciter. The exciter is rated at 200 kw, 250 v d-c, the pilot exciter at 3 kw, 250 v d-c.

The control system is entirely hydraulic, using part of the lubricating oil as the actuating medium. The main oil pump is of the centrifugal type, mounted on the shaft. Part of this oil supplies the speed governing impeller which is also mounted on the turbine shaft. The pressure in the chamber around the governor impeller is maintained by centrifugal force and varies with the square of the speed. The controlled governing pressure acts on a pressure transformer which magnifies governing pressure changes 3½ to 5 times. The magnified or secondary pressure actuates the governor servo-motor relay and thereby opens or closes the control valves.

The remainder of the oil discharged by the main oil pump flows to the main oil reservoir where part of it goes through ejectors which deliver oil from the reservoir to the pump suction. The remaining high pressure oil is reduced in pressure and then goes through the oil coolers and thence to the bearings. Oil from the bearings is drained into the reservoir. A vertical steam turbine driven centrifugal auxiliary oil pump is provided to furnish oil when starting, stopping or in emergency. This pump is started automatically by an oil pressure actuated governor in case of failure of normal bearing oil supply or it may be started by hand when starting the unit. It will cut in automatically whenever the oil pressure drops.

The turning gear oil pump is a vertical motor driven centrifugal pump and is provided primarily to furnish oil when operating on the turning gear, but it will automatically start up upon a failure of bearing oil supply, by means of a pressure switch, thus allowing the unit to be shut down safely. This pump will start automatically only if the steam driven pump fails to cut in.

Two oil coolers are provided in the main oil reservoir, so arranged that either one or both may be in service depending on the position of the tandem 3-way valve. One cooler will be adequate for cooling purposes, even with river water temperatures as high as 75 F.

LEGEND

- THERMOSTATICALLY CONTROLLED VALVE
- RELIEF VALVE
- HYDRAULIC NON-RETURN VALVE
- STRAINER
- GATE VALVE — NORMALLY CLOSED
- VENTURI TUBE
- GLOBE VALVE
- CHECK VALVE
- QUICK CLOSING STOP VALVE
- SAFETY VALVE
- FLOAT VALVE
- DRAINER OR TRAP
- LEVEL REGULATING VALVE
- SWING GATE VALVE
- PRESSURE REGULATING VALVE
- H.P. STEAM SYSTEM
- 400 # BLEED STEAM SYSTEM
- 200 # STEAM SYSTEM
- 70 # STEAM SYSTEM
- EXHAUST STEAM
- CONDENSATE, FEEDWATER & CITY WATER
- SALT WATER COOLING

PRINCIPAL TURBINE ROOM EQUIPMENT, SHERMAN CREEK STATION, UNIT NO. 9.

Turbine Generator

TURBINE—1 Westinghouse Elec. & Mfg. Co. 3600 rpm, 50,000 kw, at 0.8 pf; single cylinder impulse reaction type with one 2-row impulse stage and 16 reaction stages. Nominal steam at throttle 1600 psi gage, 950 F exhausting at 200 psi gage, 485 F with 400 psi gage bleed connection after the 10th reaction stage.

GENERATOR—1 62,500 kva, 0.8 pf, 50,000 kw, hydrogen cooled 60/85 c, 0.90 short circuit ratio, 3600 rpm; 13,800 v, 3 phase, 60 cycle, 250 v field with direct connected 200 kw, 250 v main exciter and 3 kw, 250 v pilot exciter.

Heaters

PRIMARY HEATERS—4 Ross Heater & Mfg. Co. Inc. horizontal, single pass with 157 sq ft effective surface and ¾ in. No. 18 BWG Arsenical Copper tubes.

DIRECT CONTACT HEATER—1 Ingersoll-Rand Co. Vertical, disc flow type with integral pre-cooling chamber, storage hot well and two sets of ejectors and after condenser. Rated condensing capacity 20,000 at 3 psi abs.

DEAERATING HEATER—1 Elliott Co. horizontal, direct contact tray type and vent condensers with a rated capacity of 1,100,000 lb per hr, 18 psi abs with 1000 cu ft water storage; dissolved oxygen content not to exceed 0.005 cc per liter (Schwartz-Gurney).

CLOSED FEED WATER HEATERS—2 Sets of 3 Westinghouse Elec. & Mfg. Co., vertical, 4-pass U-tube removable shell type heaters and separate hot wells; each set consisting of—one 3010 sq ft effective surface, 70 psi gage heater; one 2720 sq ft effective surface, 195 psi gage heater and one 2585 sq ft effective surface, 390 psi gage heater. Each heater has 474 ¾-in. carbon steel U-tubes.

Pumps

CONDENSATE BOOSTER PUMPS — 2 DeLaval, single stage, double suction type 275 ft TDH, 20-ft suction lift, one 1800 gpm pump driven by constant speed 1750 rpm, 250 hp, 2300 v Westinghouse motor; and one pump driven by a Murray Turbine to deliver 1800 gpm at 1160 rpm and 155 hp and 2200 gpm at 1830 rpm and 185 hp; steam 185 psi gage, 485 F exhaust 5 psi gage.

BOILER FEED PUMPS—3 Byron-Jackson Co. horizontal, 8 stage double case volute type. Normal full load 460,000 lb per hr, 1800 psi gage 222 F 4150 rpm, direct connected to G. E. Co. 1685 hp, 4340 rpm variable speed condensing automatic extraction mechanical drive turbine with automatic turning device. Steam 200 psi abs 485 F and 4 psi abs back pressure. Extraction pressure 90 lb abs.

SALT WATER COOLING PUMPS—2 Goulds, single stage, double suction horizontal split case centrifugal 2000 gpm 100 TDH at 22-ft. suction lift direct connected to 75 hp G. E. Co. 208 v, 1800 rpm motor.

HYDROGEN COOLER COOLING WATER PUMP —1 Ingersoll-Rand Co., single stage, double suction split casing centrifugal 1200 gpm 60-ft TDH direct connected to 25 hp G. E. Co. 208 v, 1800 rpm motor.

GLAND COOLING & SCALING PUMPS — 2 Worthington Pump & Mach'y Corp. 2-stage volute centrifugal, 50 gpm, 125-ft TDH direct connected to 3 hp G. E. Co. 208 v, 3600 rpm motor.

TREATED WATER MAKE-UP PUMPS — 2 Gardner-Denver Co. horizontal single stage double suction centrifugal, 300 gpm, 175-ft TDH direct connected to 20 hp Westinghouse, 208 v, 3490 rpm motor.

Crane

CRANE—1 Northern Engineering Wks., 35 ton, 4 motor electric traveling crane, Type "NE" Span 50-ft 0-in. Capacity—Bridge 35 ton, Main hoist 35 ton, Auxiliary Hoist 10 ton. 208 v motors—Main hoist 30 hp, Auxiliary Hoist 20 hp, Bridge Travel 20 hp, Trolley travel 7½ hp.

Lubricating oil is returned into a spill box from which the oil flows into the reservoir through a series of three screens of increasing fineness. The last screen is 70 mesh, fine enough to hold small metallic particles which may be picked up by the oil in the bearings. Oil to the bearings is forced through a Cuno filter which is manually rotated once a watch to keep the disc surfaces clean.

To eliminate oil and water vapors around the reservoir, a vapor extractor has been provided to exhaust these vapors and maintain a slightly sub-atmospheric pressure in the reservoir. The vapors are discharged to the roof.

To prevent the leakage of hydrogen through the shaft seals of the generator, special oil sealed glands are provided. Oil is supplied to these glands by the gland seal oil pump at a pressure maintained by a differential pressure controller at 5 psi above the gas pressure.

Oil in contact with the hydrogen is drained to a defoaming tank where most of the entrained gas breaks out and is vented to the generator casing. The level in the defoaming tank is maintained by a controller which also seals the tank. Oil draining from the defoaming tank joins the air contaminated seal oil and returns to the vacuum treating tank.

The heat picked up by the ventilating gas in the generator must be dissipated. In the systems installed by Consolidated Edison this is done indirectly by river water. The heat is transferred to fresh water circulated through gas coolers, and then transferred from fresh water to river water in the heat exchangers. This system prevents any salt water from getting into the generator in case of a gas cooler tube failure.

This completes a general description of the turbine generating unit. The condensate system and the boiler feed pumps and their control will be described in a final article to be presented in the November issue.

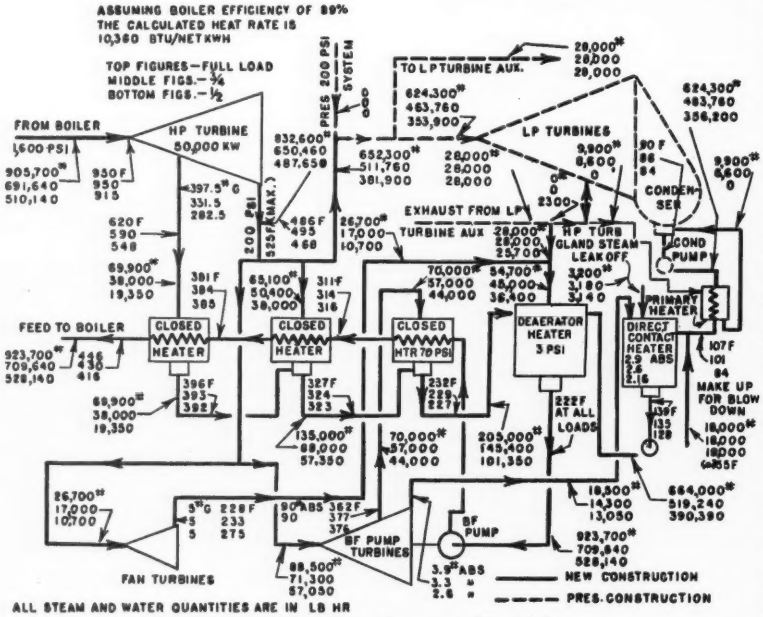


Fig. 4. Diagram showing the expected heat balance

Lignite Awaits Utilization

Among the mineral fuels, lignite constitutes 18 per cent of the nation's reserve of potential energy, yet less than two tenths of one per cent of the energy being generated from mineral fuels is secured through the use of lignite. Transportation difficulties indicate the need for locating lignite using plants in the proximity of the lignite beds or the conversion of lignite into forms of fuel easily transported and stored

By CARL J. ECKHARDT, JR.
Professor of Mechanical Engineering, The University of Texas

IT IS THE HEIGHT of improbabilities that there exists within this nation at the present time any need greater than that relating to the more purposeful utilization of its supply of potential energy in the form of mineral fuels. The existing national emergency has revealed with remarkable clarity the fallacy of the utilization pattern which has been applied and is being used in the production of liquid, gaseous and solid fuels. Too much reliance has been placed upon the hypothesis that available supplies are virtually inexhaustible and too little effort has been expanded to develop a more rational fuel utilization plan. Circumstances which have arisen have demonstrated conclusively that catastrophic difficulties may result even in a land of plenty from the dislocation of transportation facilities alone.

There is, moreover, every reason to believe that at the conclusion of the present global war economic adjustments of an international rather than national nature will make mandatory a more rational program in the exploitation of the world's natural resources. In this program the manufacture of the more critical gaseous and liquid fuels from sources of potential energy now reposing in low rank solid fuels is certain to assume a very important position.

More than 18 per cent of the nation's mineral fuel reserve consists of lignite. The preponderant portion of this vast source of potential energy is deposited in the north-central part of the United States in North Dakota and Montana. Of the remainder the greater portion, though materially smaller, is deposited in Texas.

Table I. Estimated Reserves of Lignite Available at End of 1936

State	Trillions of Btu
North Dakota	8,039,270
Montana	4,227,340
Texas	307,245
South Dakota	13,665
Others	1,210
Total	12,588,730

The extent to which the nation has drawn upon this source of potential energy is so small that more than 99.95 per cent of the original tonnage is still available.

The foregoing statement challenges the capacity for serious thinking on the part of every person who professes to be interested in the conservation of the nation's natural resources. This information becomes more significant still when it is viewed with complementary production information. At the present time less than two tenths of one per cent of the energy being converted by the nation from mineral fuels is being obtained from lignite. As might very naturally be supposed, lignite may not be regarded as the optimum fuel for many heat liberating purposes. The very fact that its characteristics are such as to impose difficulties in the case of existing utilization methods should stimulate research work calculated to render this fuel more useful and thereby project the benefits of the more admirable fuels as far into the future as possible.

The nature of lignite in its "As Mined" state is such as to preclude the probability of its being transported for utilization to points far removed from the mines with economic expediency under existing conditions. It is apparent, therefore, that its utilization program has two aspects which are worthy of serious con-

Fig. 1. View illustrating depth of uncovered lignite bed

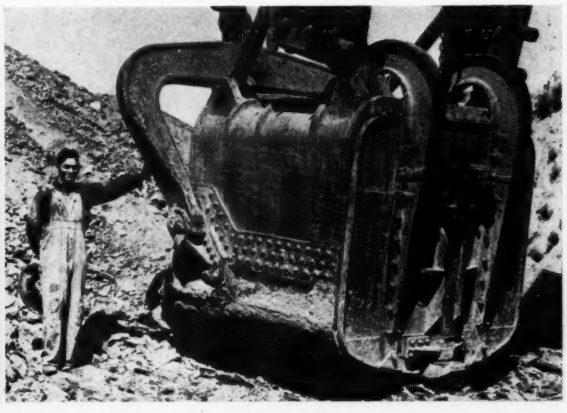


Fig. 2. Stripping shovel used to remove overburden from lignite bed

sideration, namely, (1) the construction of industrial enterprises directly upon the lignite beds provided other raw materials are available there or may be transported to such sites with facility, and (2) the development of processes by means of which the fuel itself may be converted to forms which lend themselves to greater usefulness than the original state.

The geographical distribution of the country's lignite deposits is shown in Fig. 3. Only a moment's observation is required to reveal the fact that some of these deposits of such fuel are situated in regions in which raw materials may be had in tremendous quantities. Despite the fact that in many cases the overburdens are of small consequence and may be removed with consummate ease, the number of occasions upon which industrial enterprises have established themselves directly upon such very large deposits of fuel is virtually nil. The proficiency with which the heating potential of lignite may be utilized depends upon the factors taken into consideration in the design of the heat liberating and absorbing apparatus. In Table II are shown heat balances which apply to steam generating systems employing varying degrees of refinement. All of them involve the use of lignite.

The composition of lignite varies materially in different localities and to some extent in the same locality. It is, furthermore, true that such components as ash and sulphur depend to a considerable extent upon the care with which the fuel is mined and cleaned. A typical analysis of lignite is shown in Table III together with analyses of other types of solid fuel in order that an appropriate comparison can be made.

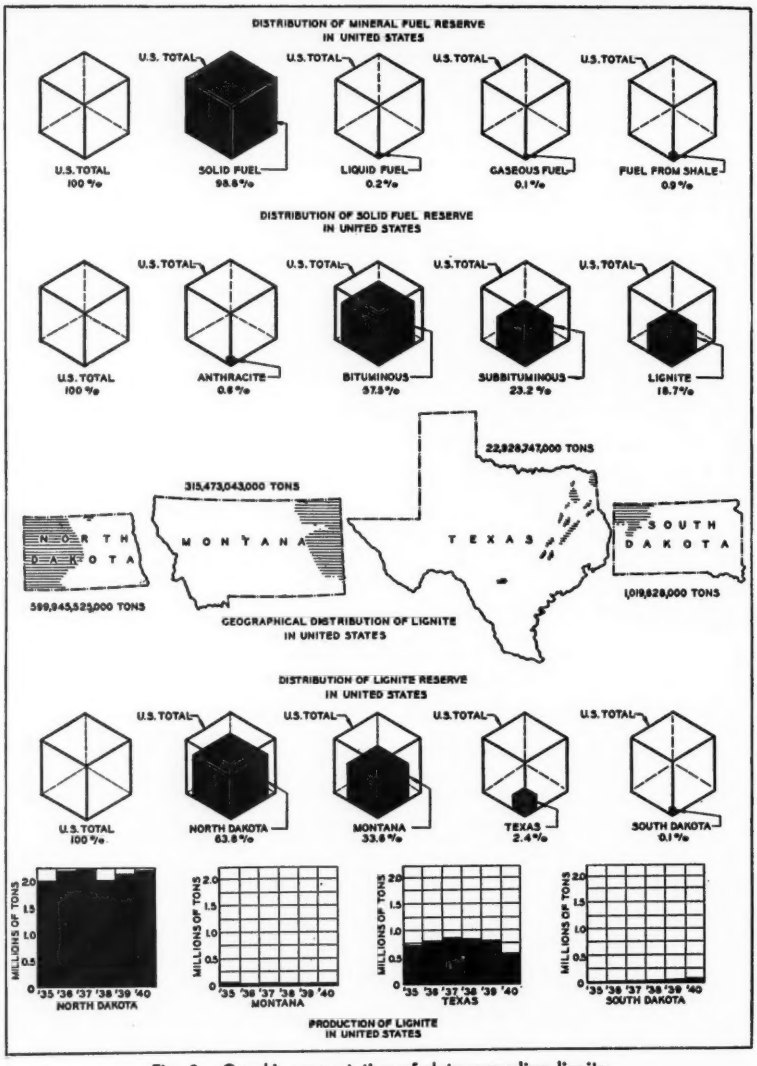


Fig. 3. Graphic presentation of data regarding lignite

The failure to utilize the potential energy which reposes in the nation's deposits of lignite cannot be justified by the fact that the more admirable fuels are being produced in such a prolific manner that shameful wastes are incurred and that fuel prices are reduced to values which stretch the imagination. The conditions last mentioned should both be regarded as the very justification for serious efforts to develop uses and processes calculated to preclude the possibility that the nation may find itself confronted with great turmoil which imposes severe sacrifices. The principal opportunities appear to lie in the following fields of endeavor:

1. The conversion of the raw lignite into more stable and useful forms by removing at least in part those constituents which render it less useful.

2. The preparation of a solid fuel involving the addition of ma-

Table II. Heat Balances of Steam Generating Systems

Item	Per Cent of Heating Potential of Fuel		
	System 1	System 2	System 3
Heat absorbed by system	55.0	74.0	80.5
Heat loss due to moisture	6.5	5.6	5.0
Heat loss due to water from H_2	4.5	4.2	4.0
Heat loss due to moisture in air	0.4	0.3	0.2
Heat loss due to dry chimney gases	15.0	8.0	7.0
Heat loss due to carbon in refuse	10.0	4.7	0.6
Heat loss due to unconsumed gaseous combustible	5.0	...	...
Radiation and unaccounted for losses	3.6	3.0	2.7
Total	100.0	100.0	100.0

System 1.—Boiler with stationary hand fired grates and natural draft with run of mine lignite.

System 2.—Boiler, superheater, air preheater, traveling grate stoker and mechanical draft with lignite crushed to uniform size.

System 3.—Boiler, superheater, water cooled furnace walls, air preheater, pulverized fuel firing system and mechanical draft.

Table III. Analysis of Solid Fuels

Constituent	Lignite	Subbituminous	Bituminous	Anthracite
Per Cent by Wgt				
Moisture	34.55	24.28	3.24	2.80
Carbon	42.40	55.28	78.00	84.36
Hydrogen	2.76	3.44	4.88	1.59
Sulphur	1.10	0.36	0.95	0.89
Nitrogen	0.57	1.07	1.28	0.63
Oxygen	11.42	12.32	4.54	1.90
Ash	7.20	3.25	7.11	7.83
Total	100.00	100.00	100.00	100.00
Heating Value, "As Received", Btu/Lb	7,090	9,376	13,919	13,298

terials not present in the fuel in its natural state.

3. The gasification of the solid fuel or development of processes by which desired materials are obtained from the solid fuel and its heating potential is recovered at least in part as a by-product process.

4. The production of liquid fuels by hydrogenation or other means.

Although many efforts have been made in the past to render lignite useful by all of these processes, most of the ventures involved have not survived because of their failure to achieve economic feasibility.

Efforts to render lignite more useful by dehydration have been made at The University of North Dakota and The University of Texas. At the former institution the investigation was conducted in conjunction with the bureau of Mines and the Fleissner Process was employed. At the latter institution the Schoch Process was developed for the purpose of producing a more stable solid fuel by reducing the moisture content in a manner calculated to reduce materially subsequent size degradation. The results of both investigations have been published.

The preparation of lignite in the form of briquettes involving the use of suitable binders has been investigated extensively. The binding substances which have appeared to offer greatest promise are starch, pitch, asphalts and petroleum residues. The lignite deposits in the South are very favorably located with reference to binding materials obtained from petroleum. Efforts to produce lignite briquettes have produced satisfactory results from a physical point of view, but they have not proven to be economically feasible under existing conditions in many cases.

The transformation of the heating potential of lignite from a solid fuel into a gaseous fuel offers great promise in the future. Great gas producing stations may be established directly upon the lignite beds. The ease with which the resulting gas can be transported indicates that sections of the nation removed from the deposits of lignite as well as those in the immediate proximity of the deposits may be supplied with a fuel which may be utilized in a very satisfactory manner. Before the advent of the extensive use of natural gas extensive use was being made in Texas of gaseous fuels produced from lignite.

There is every reason to believe that experiences imposed by the present war will establish policies in this nation which will lead to widespread uses of the low rank solid fuels for the purpose of manufacturing gasoline and other liquid fuels. In other nations possessed of very much smaller reserves of petroleum than the United States processes have not only been developed, but actual production has long since assumed a position of importance. Germany, Italy, Japan and Great Britain are among the nations employing such processes. It is estimated that in Germany alone 5,000,000 tons of gasoline are being produced annually by a hydrogenation process developed by Bergius and by subsequent modifications of that process.

Despite the fact that no section of the nation has as yet suffered any serious consequences as a result of the war which is in progress, the wisdom of developing more than a single source of a critical supply has been conclusively demonstrated. If the lessons which have been learned are to be used to strengthen the nation, then most assuredly it must not only develop the means of producing its critical materials from more than a single source, but it must also develop processes making possible the use of raw materials found in various sections of the nation to eliminate the possibility that any section of the nation may be compelled to alter the course of its living in a dangerous manner by any isolation process.

Boiler Feed Pump Governor

BOILER FEED PUMPS are always fitted with some type of governor or regulator which maintains a nearly constant pressure in the line regardless of the amount of water being used in the boiler. The action of these regulators depends largely upon the type of pump used.

With direct-acting steam driven pumps, it is customary to control the speed of the pumps by a governor valve located in the steam line. This valve is operated by the water in the feed line. A drop in pressure opens the valve, admitting more steam and speeding up the pump, while a drop in pressure has the opposite effect.

Power-driven feed pumps are generally used only in small sizes and are usually operated only at constant speed. They are designed of such a capacity as to meet the maximum demand, any excess water at light boiler loads being bypassed back to the suction through a spring loaded relief valve.

Due to the operating pressure discharge characteristic of centrifugal pumps, they are, in the usual small installations, operated at constant speed. The pressure in the feed line is allowed to rise slightly at low loads, the pump being selected to give sufficient pressure at the maximum load. In large installations, considerable power can be saved by variable speed drive. Fundamentally these governors are similar to that used for steam pumps. For steam turbines, the steam supply is varied, while for motor drive the feed line pressure is made to actuate a variable speed motor controller.

Modern high pressure, high rating plants require additional regulation and an excess pressure regulator is installed before the feedwater regulator to maintain a constant pressure differential between the steam pressure in the boiler and the pressure in the steam line just ahead of the feedwater regulator.

Tube Corrosion of Furnace Walls

This article reports in detail the steps taken to find the cause and remedy for tube corrosion of furnace walls in steam generating units of stations of Philadelphia Electric Company. It was found that this corrosion was not due to overheating or erosion but was caused by formation of eutectics that resulted in intercrystalline penetration into the tube surface and wasting of the metal. It resulted from unfavorable furnace atmospheres at certain parts of the furnace. The immediate solution was the introduction of air in such a way as to produce the correct furnace atmospheres and the ultimate solution appears to rest with the design of the burners to insure the desired atmosphere. The problem was encountered simultaneously by other utility companies, particularly in slag-tap furnaces, and a survey was made by the E.E.I. Prime Movers Committee to determine the common features. The Philadelphia Electric Company studies and conclusions were of the highest importance in analyzing the theoretical concepts underlying the problem and in leading to its solution

By George S. Gethen — *Senior Engineer, Division of Mechanical Engineering, Philadelphia Electric Company*

AT one of the Stations of the Philadelphia Electric Company, two tangentially-fired, slag-tap boilers with fin tube furnace walls were installed in 1938, each having a capacity of 600,000 lb of steam per hour at 1350 psi and 910 F.

After the initial operating period, the furnace wall tubes developed an external wasting together with receding of the tube fins and surface hair cracks. These conditions were attributed to coal erosion and water lancing of the walls to remove slag, therefore no further significance was given them at that time.

A major change in furnace design was made in June, 1940, when all the walls in the lower half of the furnaces were renewed with the bifurcated-tube construction and experiments were conducted with changes in burner positions, but this failed to alter the slag problem.

One year later, the bifurcated furnace-wall tubes were examined and gaged very carefully; however, there was no indication of the wasting or cracking as they appeared on the original finned tubes.

In November, 1941, only six months after this tube inspection, a leak developed in a bifurcated wall tube. Investigation disclosed that many of the tubes in the burner zone had been attacked, as shown in Fig. 1, and some were wasted over half their original thickness. The second boiler was then inspected and the same conditions were found.

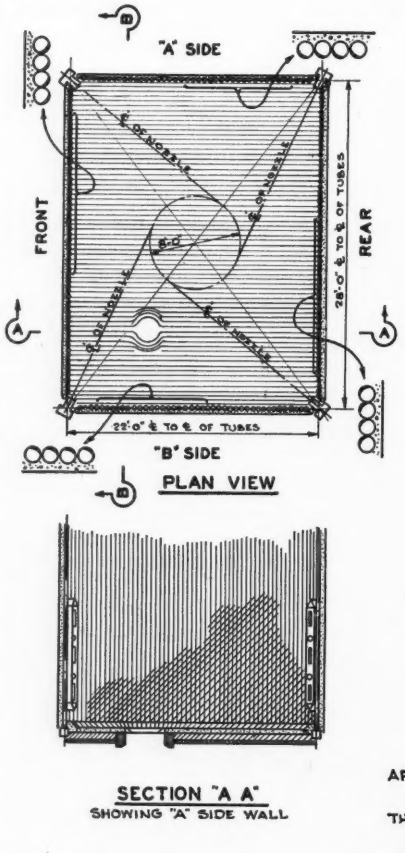

"A" SIDE
FRONT
REAR
28'-0" ℄ TO ℄ OF TUBES
22'-0" ℄ TO ℄ OF TUBES
"B" SIDE
PLAN VIEW
SECTION "A A"
SHOWING "A" SIDE WALL
SECTION "B B"
SHOWING FRONT WALL
℄ OF EXPOSED FACE
ACTUAL TUBE SECTION
AFFECTED ZONES ARE AS SHOWN BY SHADED AREAS IN THE SECTIONS AND BRACKETS IN THE PLAN VIEW. THE ENLARGED TUBE SECTIONS IN EACH CORNER OF THE PLAN VIEW SHOWS THE AREA OF THE TUBE MOST AFFECTED.

Fig. 1. Partial sections and plan of tangentially-fired, slag-tap boiler in which tube corrosion of furnace walls was first investigated

Nature of the Corrosive Attack

The affected zones formed a definite and similar pattern on all

Fig. 2. Corrosion area on side wall before slag removal. This is one of walls shown in Fig. 1

the walls starting near the bottom of the burner and reaching a height of the burner about two-thirds across the wall, falling abruptly before reaching the corner as shown in Fig. 2. The tube surface seemed to be chemically attacked, having the appearance of a burned metallic scale, multi-colored in reds and iridescent blues, intimately attached to the metal, usually accompanied by a green enamel-like coating. See Fig. 3. When this scale was removed, the tube surface, exposed to the furnace, was flattened and irregular as if washed by a corrosive fluid and in many cases the wasting was unsymmetrical.

During the previous months, coals had been burned having a higher than average sulphur content, some as high as 3.2 per cent, and the sulphur was then thought to be responsible for the corrosion attack by the formation of liquid iron sulphide.

A few wall tubes were turbined, and a small amount of scale deposit was found but not enough to cause overheating of the metal. As a further precaution to stop any slag-washing action of the tube surface, ¼ in. round bars 1 in. long were welded along the tube face every 6 in., forming slag drip ledges, and the boiler rating was limited to 500,000 lb per hr maximum output. Inspection after one month's operation revealed that a ½-in.-thick uniform slag coating was anchored to the walls by the lugs, while the slag formation above this zone was thin and spotty with a very definite line separating the slag types, 3 in. above the lugs. However, the tube metal under this heavy slag was still being attacked.

Because of the seriousness of the situation, Dr. A. E. White, metallurgist, and Mr. Shepard T. Powell, chemical engineer, were engaged as consultants. Dr. White had samples of the deposits analyzed by X-ray diffraction and by the spectrograph, and reported that the green enamel-like material consisted of 20-30 per cent Fe_2O_3; 70-80 per cent unidentified phase "A" Na; 1-5 per cent K, Li, Fe; 0.1-1.0 per cent Al. The iridescent material analyzed, 70-80 per cent FeS; 20-30 per cent Fe_3O_4.

Furnace Atmospheres

Gas samples were collected through water-cooled probes from the entire furnace area and the walls. The analyses disclosed the deficiency of oxygen and high CO in the affected zones; for example 15.3 per cent CO_2; 0.8 per cent O_2; 2.2 per cent CO; from a sample of gas taken 18 in. from a wall. Another sample 2 in. from the wall and 12 in. above the floor analyzed 11.3 per cent CO_2; trace O_2; 6.5 per cent CO.

Mr. Powell suggested that our furnace atmospheres were probably alternating between oxidizing and reducing, and also, that a series of thermo-couples should be installed on the furnace face of the tubes to maintain continuous records. These failed to indicate any high temperature condition except for a short time during the starting periods, after which the tube temperatures averaged 760 F or approximately 175 F above the saturation level. This eliminated any question of the circulation or high temperature as principal factors in this corrosion.

An affected tube was removed from one of the boilers and examined through the microscope. This revealed that an intercrystal-

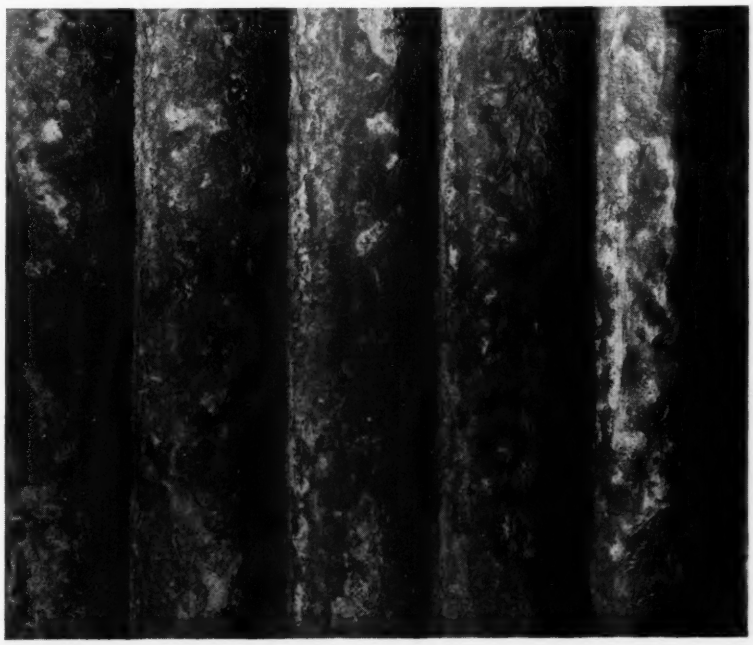


Fig. 3. Enlarged view of a portion of the affected tubes

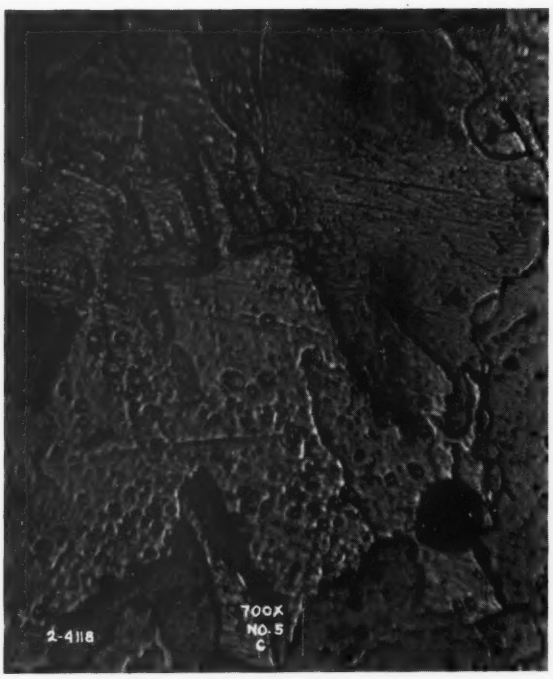


Fig. 4A. Grain structure at tube surface attacked by the corrosion, magnified 700 times. Compare with Fig. 4B

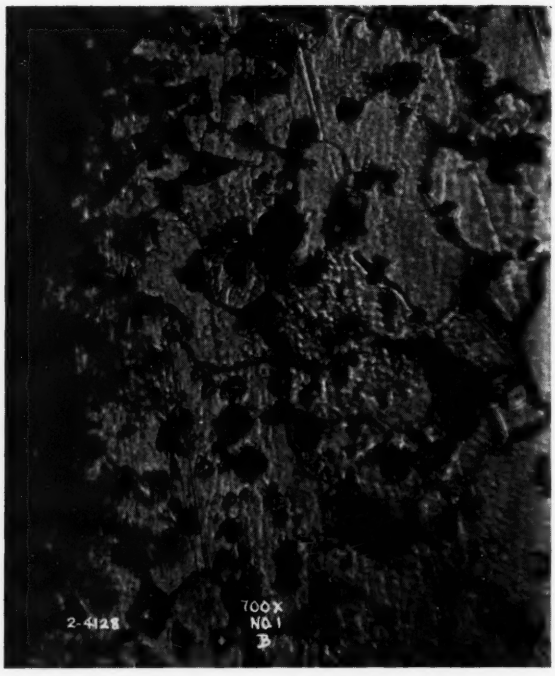


Fig. 4B. Grain structure at tube surface outside zone affected, magnified 700 times. Compare with Fig. 4A

line penetration had occurred on the fire side in the wasted area, indicating a chemical attack. The ferrite grains were not distorted but were being forced out into the slag. As a trial for stopping this action, the tubes were prepared by sandblasting and a high-temperature chrome paint was applied. Although this withstood the furnace heat, it failed to retard the corrosion attack.

Discovery in Other Boilers

By this time, it had been learned that other companies were experiencing similar tube difficulties in their slag-tap furnaces. Through the sponsorship of the Prime Movers Committee of the Edison Electric Institute, a Joint Committee was selected and, with the assistance of the boiler manufacturers, a general survey of many installations was made to determine the basic common conditions producing or preventing tube wastage.

From the results of the survey, the following operating features appeared common. Quoting from the published report of the Committee they were:

(1) External wastage of the tube metal was occurring only in slagging furnaces.
(2) Continuous or intermittent impingement of flame occurred along the walls where tube wastage was most active.
(3) There occurred a washing of the affected tubes by flowing slag.
(4) The maintenance of an atmosphere, solely reducing or fluctuating from reducing to oxidizing, was noted adjacent to the affected zone.
(5) The type of burner and mode of firing was such as to bring about some or all of the conditions noted above.

Introduction of Tertiary Air and Burner Alterations

The extreme urgency of the problem necessitated a corrective procedure at the earliest possible moment by the trial and observation method, while theoretical concept and design changes were developing.

Working from the fact that lack of oxygen always existed in tube wasting zones, an experiment was tried on a tangentially-fired boiler by introducing preheated tertiary air from the forced draft ducts through a section of wall that had been dismantled to insert a new tube, using the space between the tubes and the existing casing as a distributing air duct. The angle backing strips between the tangent tubes, the 1/16-in. inner seal plate and the wall insulation were omitted. The casing was connected by a 12 in. by 15 in. duct into the forced-draft flue. The first observation indicated that the air was blasting into the fire rather than clinging to the wall, but the slots between the closely spaced tubes remained free of slag.

A larger tertiary-air zone was then installed but with the angle strips between the tubes left in place. This alteration permitted the air to rise along the wall. This produced a porous slag, loosely attached to the tubes without uniting with the metal, and the characteristic appearance of the tube attack was thus changed to a light-brown, dusty ash coating. These observations led to the conclusion that, if an oxidizing furnace atmosphere could be maintained, the corrosion might be arrested and probably stopped.

The furnace tubes were replaced in the affected zones of these two boilers. Tertiary hot-air belts were added in all walls covering the involved areas and new vertical burners, equipped with riffle or serrated tips and air deflector plates, were installed, replacing the square discharge nozzle type.

The gas analyses showed that the combination of new burners and the air belts had corrected the reducing atmosphere on the walls except near the floor, where concentrations of 4.5 per cent CO ex-

isted. Combinations of secondary air damper settings and minimum coal flow in the bottom burner could improve the condition, but this method interfered with equalized mill operation.

Further Burner Development

A further development had been made in the tangential burners and was installed for observation on one boiler in April, 1942. This nozzle discharged a thicker band of coal in a horizontal position rather than vertical, towards the firing circle, so that the stream was not so easily distorted along the walls by secondary air admission. Vanes extended from the inlet flange to the tip of the coal nozzle, to prevent crowding of the coal to one side. Immediately above and below the coal nozzle, small sections of secondary air directed toward the center of the furnace created eddy currents, to shorten the flame and stabilize ignition near the burner tip. Above and below these small air sections were the main secondary-air ports, which directed the air along the adjacent wall.

The tertiary air in the rear wall was doubled in volume and divided between the upper and lower sections in order to force more air toward the floor. This new burner produced atmospheres along the walls free of CO, even though slag interfered with the bottom auxiliary air port and the tertiary air dampers were closed. However, the center of the furnace seemed to be inactive due to the air deflection along the walls and the flame seemed to be propagated from one side of the burner only, causing instability at low ratings. The walls were inspected after one month and found to be covered with the dry ash but the familiar corrosion appearance was absent.

A change in the secondary air vanes was then made to direct one part of the air parallel with the coal and firing circle and the other part along its wall. This improved the flame condition, but the wall atmospheres became strongly reducing.

Colored Moving Pictures

During these various changes, colored moving pictures of the furnace action, taken by the manufacturers and made at reduced speeds, were of great assistance in observing the flame patterns normally too fast for the eye. It was also apparent that low gas velocities existed in the affected zones, therefore that coal abrasion is not a function of this attack.

Latest Burner Design

From the foregoing burner trials and observations, together with the picture studies, new design horizontal riffle-tipped burners were installed on the tangentially-fired furnaces in September, 1942, which directed the coal and all the secondary air streams in parallel flow toward an 8-ft firing circle. These burners have been in service six months at this writing, with minor adjustments being made as conditions dictate. The gas analyses along the wall and tube inspections show that the corrosion has been retarded. On one boiler, the tertiary air has been shut off for two months, yet no recurrence of the condition has been noticed. A typical sample of gas taken from the wall 8 ft within the furnace, one foot above the floor, analyzed 9.1 per cent CO_2; 10.8 per cent O_2; 0.0 per cent CO.

A recent inspection of the other boiler, after operating four months with the tertiary air, showed the upper burner parts to be distorted, probably as a result of reduced air flow through the burners and its resulting cooling effect. The tube surfaces indicated that no corrosion attack had taken place except in one local spot near the floor on the rear wall, and in this particular location the corrosion has always been most active. This boiler was returned to service without tertiary air.

As a guide for observing the wastage, a special punch was made to mark the tube in a definite location. The punch has a cone point 1/16 in. high and 3/16 in. diameter joining the base. This base limits the depth of the impression. These marks are easily relocated and, from the diameter of the mark remaining, the metal wasted can be estimated and the progression noted during each inspection.

Conditions in the Second Station

While these observations were being made at the first-mentioned station, an inspection of the furnace tubes in one of the other stations showed a similar attack during the first seven months' operation. These two boilers are of the open-pass type, designed for 1350 psi, 925 F, fired vertically with six pulverized-coal burners in a single row. The tubes affected were in the front and side walls, conforming to the spread of the flame.

A complete gas analysis survey was made in the furnace and on the walls, thermocouples were installed, and a section of tube was removed and found to be clean internally. All these checks indicated a similarity to those conditions found in the first-mentioned station.

The coal and secondary air distribution at each burner was analyzed by the boiler manufacturer's test engineers. Their findings showed a heavier coal loading of the burners next to the wall where the corrosion was pronounced, while the air stream dominated the wall zones where the attack was not marked.

Attempts were made to rectify this coal distribution with vanes in the fuel pipes but, due to the physical layout of the pipes, all six approaching from one side, this plan was dropped in favor of changing and sizing the air ports to accommodate the coal flow density. This seemed to be helpful in improving the furnace-wall atmosphere.

A lengthy program has been decided on, consisting of closing off air leakage through the ash pits so that more air can be introduced with the fuel, and installing water-cooled gas sampling tubes in the furnace, one centered over each pulverizer, to check its corresponding fuel-air ratio with an oxygen recorder. Then an individual mill fuel-air-ratio adjusting device will be added to effect the correction as indicated by the recorder. A new type mixing burner will be installed for trial as soon as it can be obtained. Deslagging blowers will be installed to remove excess slag and improve heat absorption in the second open pass. Tertiary air application on these boilers does not seem practical because of the equipment arrangement.

Conditions in the Third Station

In two straight-tube boilers installed in another station, in 1935, using pulverized coal from a storage system, vertically fired by eight burners arranged in two rows across the boiler, operating at 425 psi, 850 F, an examination of the primary furnace tubes showed that wasting had been progressing. During the seven years, repairs to the studs of these fully-studded tubes had been made and considered as ordinary maintenance. The dust or lower screen tubes, originally 7/16 in. thick, measured a loss of 3/16 in. near the uptake water wall, and some spots of side wall tubes were wasted below the studs.

The boiler manufacturer analyzed the furnace atmospheres and recommended firing the minimum coal with maximum secondary air

flow through the second row of burners from the front wall and maximum coal with the minimum secondary air flow through the burners along the front wall, to prevent the reversal of air up the wall and across the burner arch without mixing in the primary furnace. These boilers have now operated over one year using this method and the wall attack has been arrested.

Other Experiments

Tests of various materials applied to the tubes were carried out in boilers of another committee member. These consisted of calorizing sections of tubes, sprayed aluminum and sprayed stainless steel (18-8), silver plating and high temperature aluminum paints, but all failed to show promise of correcting the corrosion. A section of wall was covered with horizontal stud plates welded to the tube face on 4-in. centers and filled with plastic chrome ore. Although the studs burned back, the tubes were untouched. This method of applying studs is naturally slow and costly for a general application.

Theoretical Concept of the Cause of the Attack

The eutectic theory was brought forward by Dr. White as accounting for the chemical attack by a relatively low temperature eutectic, consisting of complex iron-sulphur compounds, principally Fe-FeS and FeO-FeS mixtures. Undoubtedly, many intermediate substances were likewise formed. It is well known that such eutectics can and do occur when certain chemical and thermal conditions are present.

Simple tests conducted in the laboratory, duplicating so far as possible the furnace conditions, consisted of the preparation of various mixtures of sulphur compounds and alkaline salts. The mixtures were then placed in a good section of the boiler tubing with cover plates, and heated in an electric furnace. The apparatus was so arranged as to carry out the tests in a reducing atmosphere. Under these conditions, the compound could result in the formation of a simple or a complex eutectic with iron.

The temperatures under which the tests were conducted were varied, and the attack on the metal during a given period of time was observed. Metallurgical examinations were made of the metal in contact with these various mixtures after the completion of each test run. Photomicrographs of this metal showed the same condition of intercrystalline penetration as appeared in the wasted tube specimen.

As a result of this study, it would appear that the wastage is due to the development of eutectics, which might form under a reducing atmosphere, and that when these eutectics were in an oxidizing atmosphere, as occurred from time to time, they would be converted over into compounds or eutectics of an oxidizing nature. It is possible, of course, that eutectics in which oxygen was one of the elements might be formed directly, although it is more probable that the cycle just mentioned was the one that took place. Some of the elements that in the form of sulphides or more complicated forms, would contribute to the formation of the eutectics, are iron, potassium, lithium and sodium.

Ultimate Solution of the Problem

The use of the air belts supplying tertiary air through the affected wall zones was recognized as a temporary expedient and as a means of checking accelerated corrosive attack on the tubes until a more permanent solution to the problem could be developed and practically applied. This application accomplished the purpose in most cases. The ultimate solution appears to rest with the design of the burners to effect combustion at all times in such a manner as to insure an oxidizing atmosphere and furnish gases of relatively uniform composition along the walls in the areas subject to attack. This problem falls logically within the responsibility of the manufacturers, to provide equipment to bring about these essential furnace conditions.

Conclusions and Recommendations

The following conclusions and recommendations are taken from the published report of the Committee:

1. The external corrosion resulting in thinning of furnace wall tubes is the result of chemical attack and is not due to overheating or erosion.
2. The most plausible explanation for the attack is the formation of iron-sulphide/iron-oxide or other complex eutectics between the metal and the outside layer, which ultimately results in intercrystalline penetration into the tube surface and wasting away of the metal.
3. This condition is brought about by an unfavorable furnace atmosphere close to the surface of the tube; this atmosphere alternately fluctuates from reducing to oxidizing and back again to reducing. Sulphur compounds, alkalies and other elements in the slag play an important part in the destructive action.
4. The ultimate solution to the problem is the selection of a proper burner design to insure maintenance of fuel ignition close to the burner and at the same time to insure sufficient oxygen in the furnace atmosphere so that this gas will, at all times, be adjacent to the walls where the flame is propagated.

Solving the Tin Shortage Problem

SAVINGS OF MORE THAN 99 per cent in the tin content of bearing babbitt, and the possibility of completely eliminating costly anchoring methods were two of the outstanding advantages recently claimed as a result of tests being made at The Cooper-Bessemer Corp.

The Kolene process is designed to provide an exceptionally firm and uniform bond between lead-base babbitt alloy and the Mechanite Metal from which Cooper-Bessemer bearing shells are cast.

The bearing shells are first dipped into a hot molten salt bath to remove the carbon (graphite) particles common in cast iron. By cleaning out their particles in the metal, a considerable amount of anchoring surface is added for bonding the babbitt. After rinsing, the backings are placed in another salt bath to reduce surface oxidation resulting from the first.

The backings are again rinsed and suspended for a few seconds in cold hydrochloric acid before they are dipped in a flux and placed in a low tin-content alloy which forms a uniform coating on the bearing surface.

The bearing packings, so coated, are placed in proper jigs, and babbitt is poured against them, which readily forms the tight bond necessary to stand the pressure and stresses of operation.

The bonding is so uniform and firm that the manufacturer has been able to reduce the bearing thickness to a small fraction of the bearing thickness formerly required. According to the manufacturer, this thin bearing alloy has stood up remarkably well under the most severe testing conditions.

Selecting Short-Circuit Protection For L. V. Motor Circuits

By W. G. TAYLOR
Industrial Engineering Department
General Electric Company

This article by Mr. Taylor of the General Electric Co. answers a number of questions that probably have bothered many operators from time to time. What kind of protection should be provided for motor circuits; shall circuit breakers or fuses be installed; if circuit breakers, what kind, what capacity; if fuses, what type and also, what size? Which of these are cheaper, which provide the better type of protection? How effective are the various types of protection and which is preferable in certain cases? Mr. Taylor discusses all of these matters from the practical viewpoint, from the viewpoint of the operator in the plant who has to make up his mind and do something about these things. It's the real "dope," no foolin'

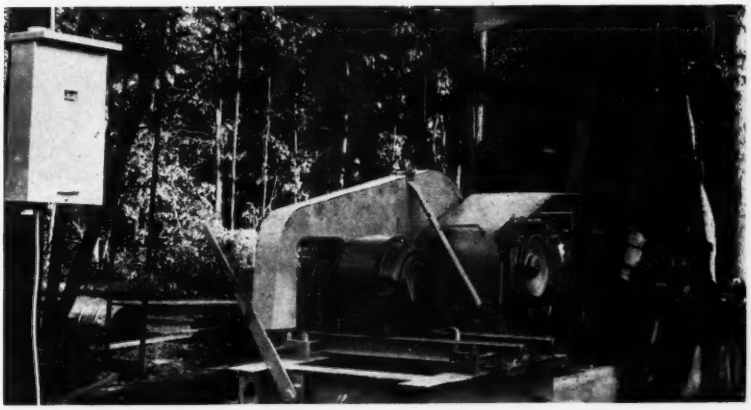


Fig. 1. Combination motor starter in a weatherproof enclosure, mounted adjacent to the oil-well pumping jack it controls

EVERY INDUSTRY employing electric power has occasion to use either fuses or circuit breakers, in order to protect low-voltage motors and control apparatus from the abnormally high currents caused by accidental short circuits. Fuses are the oldest—but certainly not an outmoded—form of such protection. They must be refilled or replaced, after being blown, as opposed to circuit breakers—a later development—which are reclosable without replacement.

Either type of short-circuit protection must meet two requirements:

1. It must recognize the fault condition and open the circuit at the predetermined current level;

2. It must have sufficient interrupting capacity to stop the flow of abnormal current, however high it may be.

Since the most extensive application of these protective devices is on low-voltage circuits, this discussion will be confined to equipment designed for applications up to 600 v. To further define this comparison, distinction must be made between non-renewable and renewable cartridge-type fuses, and also between the two fundamental designs of circuit breakers, "thermal" and "magnetic." The latter names are derived from the type of overload trip for which each was designed, but their inherent difference is more basic.

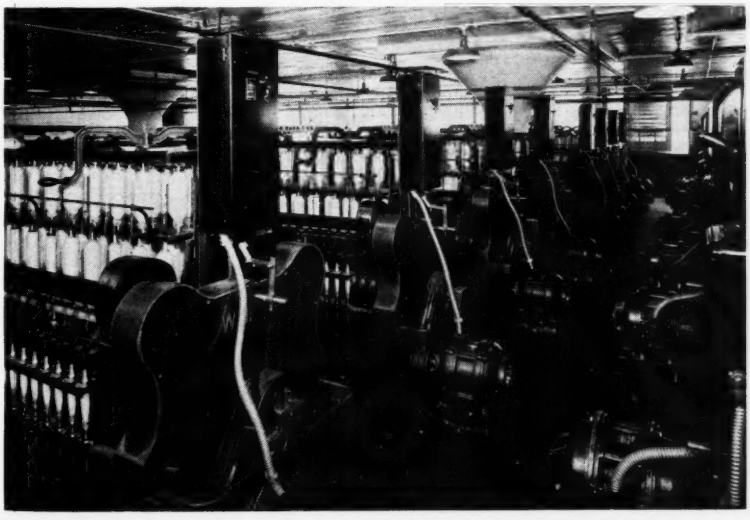


Fig. 2. Widely used in textile mills, these combination motor starters, equipped with shipper-rod switches, are used to control the operation of a spinning-frame drive

Fuses

Because of its smaller interrupting capacity and its possibilities of more erratic action, the renewable fuse will not be considered. The greater interrupting capacity of the non-renewable fuse is due to the arc-quenching action of the filler within the cartridge. Its greater reliability results from soldered contacts instead of hand-tightened-screw contacts for the fuse links.

Only high-quality NEC fuses, consistent in their operating performance, are considered here—such as those rigidly clamped in vise-type terminals which make full contact under pressure. This arrangement (1) provides insurance against blown-fuse trouble caused by overheating from poor contact; (2) holds the fuses in place during heavy-short-circuit currents.

Circuit Breakers

Because of its wide and proper use for the protection of main feeder, and branch circuits, the magnetic circuit breaker has a relatively high interrupting capacity. Although it is sometimes equipped

with both a thermal and a magnetic trip, its fundamental design as a magnetic breaker remains unchanged. Being a product of higher quality and cost than the thermal breaker, which it antedates, and too expensive for competition with fuses for individual lighting-circuit protection, it is built only in the larger sizes. Because of its cost, it is seldom used for individual small motor protection, and it is therefore excluded from this comparison.

THERMAL BREAKER

Originally developed as a competitive substitute for fuses in lighting distribution panel boards, the thermal breaker incorporates low cost at the expense of many of the better mechanical features found in the higher-priced magnetic breaker. It thus sacrifices fast, consistent operation, and has a lower interrupting capacity. Equipped at first with only a thermal device for tripping it on overloads, its use was extended by larger sizes to motor protection also. Where, in some cases, an instantaneous magnetic trip has been added, there has been no fundamental change in mechanical or electrical design, or in interrupting capacity. It remains the inexpensive type.

Comparison of Fuses and Thermal Breakers

This comparison can now be resolved into its component parts, that is, fuses and thermal air circuit breakers as utilized in combination motor starters for short-circuit protection. There is a wide field of application for both devices in industrial service, especially as incorporated in combination motor starters, which are available in standard designs up through ratings of 200 hp (Figs. 1 and 2).

Specifically, this comparison is between high-quality, non-renewable, low-voltage, clamped-in, cartridge-type, NEC fuses and thermal, low-voltage air circuit breakers (Figs. 3 and 4).

The fuse is faster; that is, it will open the circuit with any short-circuit current, within its interrupting ability, in a shorter time than a thermal breaker that is not equipped with instantaneous trips. When the latter are added, the breaker may operate as fast as, or faster than, a fuse on moderate overcurrents, but in this current range either a fuse or a breaker will be fast enough to give adequate protection. As the magnitude of the fault current increases, however, the speed of opening of the fuse increases in proportion to the square of the current, and becomes faster than that of the breaker. The fuse will take a motor off the line before fault current has had time to build up to its maximum value; but the thermal breaker may not open the line until after maximum current has been reached. The fuse, therefore, offers the better protection, as the equipment thus protected has much less chance of being damaged by fault current.

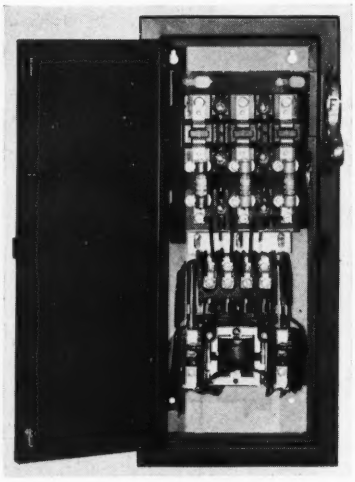


Fig. 3. Combination low-voltage motor starter with fusible disconnecting switch and vise-type fuse clips

INTERRUPTING CAPACITY AND CURRENT-LIMITING EFFECT

The non-renewable fuse has higher interrupting capacity and more current-limiting effect than the thermal breaker. Low-voltage systems supplied from transformers are likely to have available * short-circuit currents at least from 10,000 to 20,000 amps, with a strong probability that they will be considerably over 30,000 amps. Tests have demonstrated that cartridge-type fuses are capable of opening short circuits on such systems successfully, largely because of the fast action of the fuses and their current-limiting effect, both of which arrest the rapid rise of fault current. Thermal breakers, on the other hand, cannot be depended upon to open circuits with available short-circuit currents beyond their rated interrupting capacity, which is 5000, 10,000, or 20,000 amp.

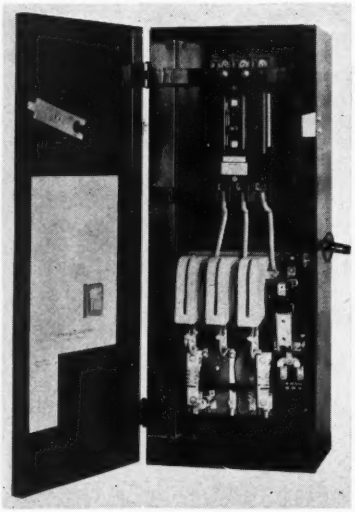


Fig. 4. Combination low-voltage motor starter with thermal air circuit breaker

The non-renewable fuse has no moving parts to wear or be adjusted; in fact, it is one of the most consistent and reliable short-circuit protective devices known. Its value is enhanced by the fact that modern fuses for motor-circuit protection have cadmium-plated or silver-plated metal ferrules and fuse clips, hence there is little chance for corrosion which might produce local heating and result in premature blowing of a fuse. The value of this fuse is further enhanced by the use of vise-type terminals which assure good contact under pressure, resulting in less possibility of local heating.

When a fuse burns out, it opens the circuit; in other words, it "fails safe." If its characteristics change at all, it will blow at a lower rather than at a higher current.

CALIBRATION

The trip settings of thermal air circuit breakers are calibrated at the factory and are not adjustable in the field. If a change is made in the field by changing the thermal elements of the tripping mechanism, there is no certainty (except in the case of a very few designs) that the calibration will be correct, as in most designs the thermal trip should be calibrated with—and in—the breaker to assure accuracy; and this is obviously a factory operation. On the other hand, if a change in the rating of a fuse is desired, this is done in all cases by inserting a fuse of different capacity (of course within the limitation of the capacity of the fuse support).

OUTAGE TIME

Replacement of a blown fuse does not necessarily or usually cause any costly production delay. Sometimes a short circuit of sufficient intensity to blow a fuse or open a

*Available current is the maximum current which will flow in a circuit if the interrupting device under consideration is considered to have negligible impedance.

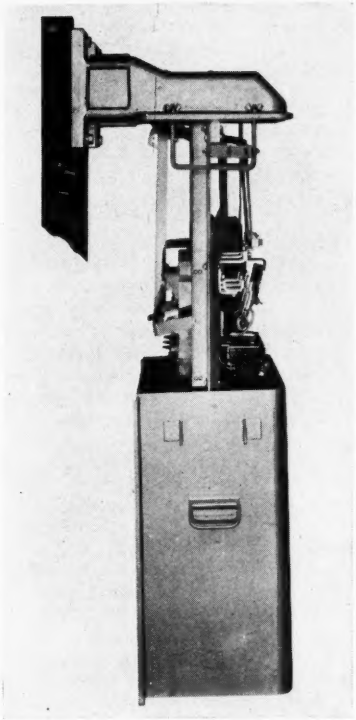


Fig. 5. These oil-immersed combinations are made in two forms—for both corrosive and hazardous locations, and are available in ratings through NEMA Size 5

breaker may require that some work be done on the starter, the motor, or the wiring, to eliminate the fault. This may make it advisable to check the condition of devices in the circuit and perhaps to dress some contacts. If this should be the case, it will usually take longer than the time required to obtain and insert new fuses.

Cost

Combination starters with fusible manual switches are consistently lower in cost than similarly rated combinations using thermal breakers. Therefore, the fused switch not only will give better protection but will do so at less cost.

It is not often that a device of lower cost will do a better job. The fuse is, therefore, an example of interest to a wide circle of users. The circuit breaker has appealed to many because a motor circuit can be re-established by closing the breaker, while blown fuses must be replaced. Some may have given little thought to the fact that power service cannot be restored successfully until the fault is removed, and sometimes not until devices in the circuit have been serviced—all of which takes time. For these reasons, a gain in time is not always assured with a breaker in a motor starter, except possibly when the starter is oil-immersed or in an explosion-proof enclosure.

Applications

Space limitations in the design of some types of low-voltage control assemblies make it advisable to use circuit breakers rather than fuses when the physical size of the fused switch is considerably larger than that of the corresponding breaker. Individual fusible combination motor starters, however, are available in all sizes up through 800-amp fuse-clip capacity.

Infrequent Short Circuits

It should not be overlooked that a motor and its starter and the circuit between them (protected by fuses or a circuit breaker) are seldom subjected to conditions which produce short circuits. Such protective devices, therefore, are called upon to open the circuit only in comparatively rare cases, and the time lost in putting them back into service is not likely to amount to much over a long period.

Frequent Short Circuits

Low-voltage power feeder circuits, on the other hand, may be subjected to such conditions as storms, lightning, falling objects, etc., which most individual motor circuits may never encounter, and so feeder circuit interruption is likely to be more frequent. Many of these troubles on a feeder circuit may be self-clearing, but nevertheless they are likely to trip the feeder breaker. Because the shut down of a feeder usually involves an extensive load and may also mean revenue lost to the power company, it is very important to get the feeder back on the line promptly. Circuit breakers often permit a quicker re-establishment of such service and therefore are recommended.

Protection Against Single Phase

One point sometimes considered in favor of a circuit breaker for a motor circuit is that it will open simultaneously all three lines of a three-phase circuit, thus making it impossible for the motor to be left energized by a single phase after a fault has occurred.

On the other hand, this possibility on a fused circuit is remote. If the low-voltage system is ungrounded, a short circuit or accidental grounds on two phases, will blow two of the three fuses. A single ground will have no effect on operation. On a system with grounded neutral, an accidental ground will blow one fuse, but the increased motor current on the resulting single-phase operation will actuate a properly adjusted overload trip on the motor starter, and thus take the motor off the line. It is unnecessary, therefore, to use a circuit breaker to insure such protection. A three-pole breaker would, however, provide greater safety to anyone so careless as to contact an interrupted circuit before opening the line disconnecting switch.

Oil Immersion

The use of the cartridge-type fuse element or the bimetallic strip of a conventional thermal-trip device for oil immersion is impractical since neither will retain its tripping characteristics when directly immersed in oil; when cartridge-type fuses blow in oil they vaporize it and produce dangerously high pressures within the cartridge. Conventional fuses in a submerged air compartment are effective if no oil leaks in. But to be safe, the construction must be absolutely leak-proof—a construction difficult to obtain. However, oil-immersed circuit breakers are available in combination with magnetic motor-starting switches (Fig. 5). The best of these breakers have better construction for oil immersion and higher interrupting capacity than the conventional thermal breakers, and are equipped with instantaneous magnetic trips. Such breakers are, of course, more expensive. Combination starters which include these breakers also incorporate the highly successful oil-immersed, induction-type temperature overload relays, which, however, act on the starting switch instead of the breaker and are provided for overload, not short-circuit protection.

(*Continued on page* 134)

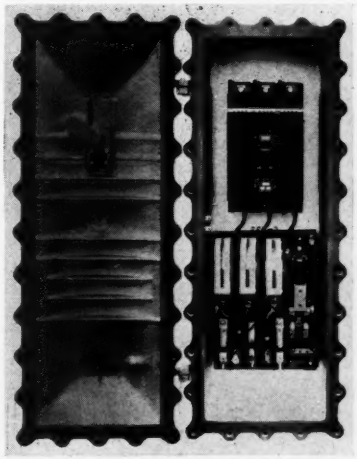


Fig. 6. Enclosed in a high-strength alloy case, this combination motor starter is designed for use in hazardous gas locations

The Outdoor Plant—Is It Here To Stay?

OF ALL the letters received on this subject, POWER PLANT ENGINEERING'S editors considered this one, on the whole, the best discussion of it. Others were much more technical, still others were splendid examples of argumentative writing. But this one was awarded the prize because it had the ring of the practical man's hard-won knowledge.

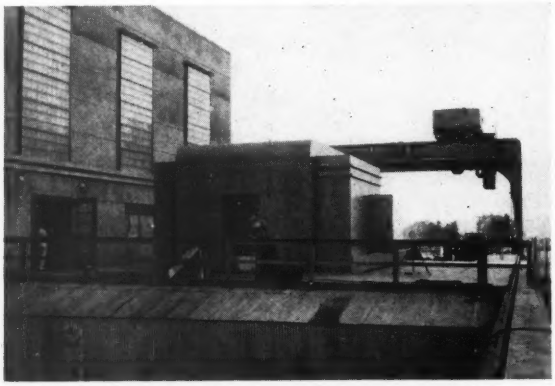


Fig. 1. The Glendale turbine unit, visible through open door in end of cubicle. Pit in foreground is for future additional unit

PRIZE-WINNING LETTER

Is the Outdoor Installation Here to Stay?

By Bill Maddock, M.E.

THIS IS one of those questions where the only real answer is, "Well, yes and no." Yes, the modified or semi-outdoor design of the late 1930's is still going to be followed, to an even greater extent in localities where weather conditions will permit. No, it will not be accepted universally.

In the first place, most of our outdoor installations are not truly out of doors, but the protecting houses or coverings have been reduced in size to where in some cases the housing has been incorporated in the machine design. They are of the same design as the totally-enclosed motor, the hermetically-sealed refrigeration unit, the hydrogen-cooled synchronous condenser, and, most common, the steam locomotive.

In the design of a B & W 825-psi, 825-F integral-furnace steam generator complete with air preheater, draft fans, and stack, the steel casing was made weather tight. The motors were of splash-proof construction and all well above ground or flood waters. The parts actually exposed to weather were: 1, Burner registers; 2, Water column and level controller; 3, Fan couplings and shafts. The remote-control panel board was separated from the boiler by a glass wall that permitted full vision to the burners and water column. Yet in 1936 this was heralded as an outdoor boiler, on the technicality that the housing was not supported from a separate foundation or wall structure.

From an operator's standpoint there has never been any difficulty with this unit. Located in Southern Arizona, the installation has relieved the operators of some pretty tough firing aisle temperatures. The use factor has been over 97 per cent. At no time has rusting been a problem, nor has the weather ever been so bad that the unit has suffered from lack of attention. At any cost, it does not seem that a more favorable treatment could have been chosen from an operating point of view.

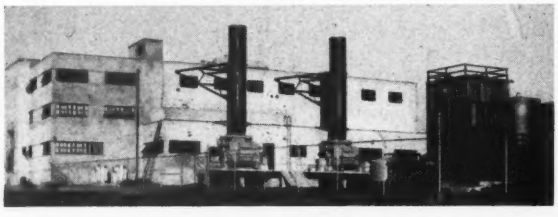
At two of the municipal plants in Southern California the boilers have been placed inside even though they were steel encased. Oddly enough, the turbines were put outside. The G.E. design called for a small cubicle to cover the turbine-generator set, back to the generator coupling. The generator was a hydrogen-cooled unit with its own water-cooled system. If there had been three stories of building over the generator, it could not have been better shielded from rain and wind. The weak spot turned out to be the exciter coupling, but it, too, was finally fixed to eliminate the rain. Out of doors? Certainly not, just a much-reduced size of the conventional building. See Fig. 1.

Operation here isn't so outstandingly favorable to the selection. First of all, the rapid changes in temperature in this more or less humid climate have led to considerable condensation in the lube oil tanks. This condition was aggravated at first by a daily shut-down of over 12 hr. Next, the small cracker-box cubicle magnifies and resonates annoying sounds and physically cramps the operator in the performance of his duties. There are definitely rainy seasons, when getting wet is as sure as fate. Repair work at such times is certainly handicapped by tarps and the like, and considerable time is lost on the repair in knocking down the cubicle to get the cylinder open.

All the auxiliaries are below the floor in an excessively large basement. The saving on construction was one story on one wing of a three-story building. The extras of construction were increased basement size to take care of auxiliaries normally housed in the turbine room, a more expensive type of crane, and the steel cubicle. Time will tell if it turns out to be a net saving.

More recently there has been a battery of 12 boilers set outdoors in Southern California. All 12 are metal cased and installed in two rows of six each, facing each other on a common firing aisle. The access platform to the boiler drums has been made to be the roof for the firing aisle, although there are no walls as such for the boilers. A separate room houses the feed pumps and a few other auxiliaries, as well as the meters and controls. Outdoors? No, just adequately ventilated.

Certain items must be housed in one way or another. Switch-gear has to be enclosed integrally or in a room; the same applies to other controls and to electrical meters. Laboratory, office, record room, storage room, and change rooms all call for walls and roof. On the other hand, water treating systems are seldom housed except to keep them from freezing. It is surely not uncommon for motor pumps or unit engine-driven machines to be placed outside.



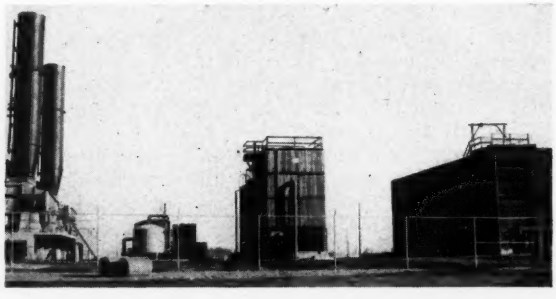


Fig. 2. (Above) Rear view of Glendale plant, showing induced draft fans, stacks and generator cooling tower

Fig. 3. (Right) Another view of Glendale; fans and stacks, water treating filters, generator cooling tower, part of 20,000 gpm cooling tower

The logical thing to do is to try to keep from "double housing." Why pay a manufacturer for a totally-enclosed 500-hp motor and then put a 12 by 12-ft shed around it? Also, put the noisy things outside. A high-speed forced-draft fan is a fine thing to put outside on account of the noise at the inlets.

But above all, remember that when the buildings are pre-shrunk so as to fit the equipment closely, it is not the machine that is being put in the open; it is the man. When the man is exposed to the weather, the machine is exposed to something worse — neglect!

Following are extracts from two of the other letters. Mr. Gillerman calls attention to the ways in which outdoor temperatures might affect plant maintenance and efficiency and gives figures on auxiliary efficiencies as compared with boiler and generator heat losses, to show that the latter affect overall plant efficiency more than slight improvements in auxiliary efficiency.

Mr. Krechefsky emphasizes the handicaps under which both maintenance and operating crews work in outdoor plants.

The Outdoor Power Plant—Why?
By Harvey M. Gillerman

IN THIS era of modern industrial design, why do some of us seek to amplify present troubles? Recent trends in industrial architecture tend toward utilitarian design with esthetic influence. Excellent! But why, because modernistic exteriors have become functional, must we move interior apparatus and auxiliaries outside?

In some parts of this country, temperatures in the sun sometimes exceed 110 F, which condition would reduce outdoor units to a new low in efficiency. Under such conditions, condenser area must increase; pump sizes must increase; generators will operate under higher ambient temperatures with increased cooling required for both bearings and field; water rates will increase; and a lower overall plant efficiency will result.

Under the above conditions, maintenance programs would have to be expanded and accelerated, with increased labor costs as well as shorter periods between overhauls and replacement of parts. Plant factors would drop in proportion to total shut-down time, and more stand-by apparatus would have to be installed if the same availability is desired.

Appearance is more a result of machine design than of architectural effect. Regardless of utilitarian advantages, both for construction and maintenance, external I-beams and channels forming the boiler framework, external piping with masses of lagging, superimposed roofs over the boiler, all tend to make the plant look more like a 19th century English colliery than a 20th century modern power plant.

Any advantages supposedly gained by increased space for cleaning and other maintenance can be cancelled by observing the construction of most power plants, in which the steam generators face the electric generating room with the centerline of the electrical units parallel to the firing aisle. In this construction, all space above the generating room is free for any large boiler-room pieces that must be worked from the side. One crane, with travelling bridge and travelling trolley, will suffice for both steam and electric generating units.

The whole question resolves itself, ultimately, into whether fixed charges will be reduced and at the same time bring about concomitant production costs so that total cost per kilowatt-hour will be reduced.

I, for one, would much prefer to work indoors rather than alternately inside and outside. Most maintenance and installation would be done in the open, at the mercy of the weather, with perhaps rapidly changing conditions. This factor in itself would tend toward higher labor cost and higher labor turnover due to poorer working conditions. . . .

Taxes might be reduced slightly because of the lower first cost claimed (although special design for outdoor equipment might result in the same or even greater costs), but insurance might be higher than for completely housed plants, since the risk due to natural causes would be greater, as well as risk due to increased possibility of boiler explosion, damage to generator winding, increased sludge in forced feed lubrication lines, combustion chamber spalling and cracking, internal and external erosion, unexpected settling of settings and foundations, unreliability of instruments as warning devices for abnormal conditions, and the increased human element. Depreciation would be greater due to greater exposure and plant life would be inversely affected. The risk involved in the investment would be greater, and if any separate bond issue were required, the bonds would probably be sold under par, with a resultant increased first cost. . . .

Some proponents of the outdoor plant have pointed out that some auxiliaries will operate more efficiently outdoors. . . . Let us examine the following figures to see just what effect a slight increase in efficiency of an auxiliary will have on overall plant efficiency. The figures are per cent of overall efficiency based on 100 per cent overall plant efficiency: stoker operation, 0.4; draft fans, 1.5; and miscellaneous auxiliaries, 1.3; totaling 3.2 per cent of overall energy. Losses by boiler radiation, 3.0; generator losses by heat, 1.0; and economizer gains, 5.0. These figures do not always hold, it is true, but are fairly indicative.

It can be seen that total auxiliary operation requires about as much energy as boiler radiation loses. Therefore total plant efficiency would be more greatly influenced by boiler losses than by any slight gain in efficiency of auxiliary operation.

Thus, it is my belief that, considering energy losses, initial cost, fixed charges, production costs and other pertinent data, the completely housed power plant is more economical. With just slightly more effort than has previously been expended, it can be made more functional and esthetic, both inside and out, than either the semi-housed or outdoor plant.

The Outdoor Power Plant
By S. L. Krechefsky

IN OUTDOOR PLANTS, location, initial investment and type of service are overshadowed by maintenance costs. Various parts of boiler or turbine equipment must be dismantled for service and repairs. How are the heavy parts to be handled? . . . Cranes would be of the gantry type requiring much structural steel which could have gone into the superstructure of an indoor plant. The same is true for trolley beams. Trolley beams can be easily supported from floor beams, wind bracing or building columns. In the case of the outdoor plant, we must again resort to the use of steel supports which could have gone into the superstructure of an indoor plant. . . .

In sub-zero or 100-degree weather, the forgotten maintenance crew is out there, first battling the elements and next attempting to do the work at hand, while the designer sits in his air-conditioned office figuring out how much he has saved the investors when they accepted his brain-child and built the outdoor power plant.

The number of man-hours lost due to sickness and accidents will be much greater at an outdoor power plant than at an indoor power plant.

The morale of men working at an outdoor power plant will not be as high as for men working at an indoor plant.

Equipment will be inspected more often and thoroughly when all is protected and when the operator can be relieved of his unnecessary wearing apparel or equipment, such as hip boots and snow shovel, so necessary for work around an outdoor power plant. . . .

By the time all the equipment covers are built, would it not be more sensible to build one big cover over the plant and show a saving in heat, a higher overall efficiency and at the same time satisfy the men who must literally live with the plant?

HITLER IS A HARD MAN to reach by telephone these days. And even if you could pick up the phone and dial Berlin, he probably wouldn't understand you because he doesn't talk our kind of language.

Hitler is an easy man to reach by way of the grapevine of rumor and loose talking. And when his agents overhear you talking shop, you may be talking a language that Hitler understands. Don't let Adolf's stool-pigeons tap in on your conversation. And just to make sure that you don't spill the beans around the wrong guy, don't talk shop. That's the best way to short-circuit Hitler's party line in America.

STOP THAT LEAK!

Every type of boiler setting has peculiar construction details that need to be watched carefully for indications of air leakage which lowers combustion efficiency. The most common locations of these leaks are cited here for several types of settings and the use of combustion instruments detecting air leakage losses is explained

By Leon S. Lyon

LIKE THE well known hound dog there are a thousand and one types of boilers, similar to the commonly known horizontal return tubular, Fig. 1, yet it is often quite impossible to name the breed. Some must have come over on the Mayflower, and yet in many cases time has dealt kindly. Literally thousands of them in use are wasting large quantities of fuel, truly "forgotten boilers" and in good times they were too small for the efficiency man to notice.

Even as in large sizes, this boiler consists of tubes and drum set in a brick or metal structure. Probably no type of boiler has stood more abuse yet we have seen them extremely old and seemingly dilapidated (in fact with part of the brick of the rear arch piled along the fireroom wall) and with efficiency a little better than a bonfire, yet with brick reset and sealed and with doors made to fit, they were made extremely efficient. Some are burning wood waste with maximum CO_2 of 20 per cent. We have seen one come up from 4 per cent CO_2 to 17 per cent CO_2 by only making the repairs anyone could make, such as follows (Fig. 1):

A—Air leaks through foundation can be serious and hard to find. Lay tight bottom.

B—Brick wall may be "crazed" like an old china plate. Where bricks are loose, relay and seal all leaks.

C—Fire doors and ash pit doors and shutters are often loose and warped. If doors are warped, build up with weld, and grind to fit to shut off any air leak.

D—Air leaks over the top of the setting may be more serious than side wall leaks although often neglected when side walls are sealed.

E—A loose fitting clean out door may be the reason why you have to clean out so often.

F—Rear and side doors and frames are often loose and neglected and should be extra tight.

G—Back arch, regardless of construction, must be tight. If it has to be taken down to replace tubes, don't pile the brick along the fireroom wall and merely shovel the rubble back. Relay the brick and seal tight with asbestos-asphaltum boiler seal.

H—See that the damper is in good repair. On damper pull chain provide for adjustment in intervals of ¼ in., or use turnbuckle.

I—Take combustion analysis here, CO_2 with Orsat. Temperature with armored thermometer. (On one that could only hold 65 lb. of steam, we saw a fuel saving of $125 per mo.)

J—If the above instructions have been followed, you won't have to clean tubes much, except to brush out.

K—Take operating firebox draft here. Stack draft at I. Differential or draft loss at both.

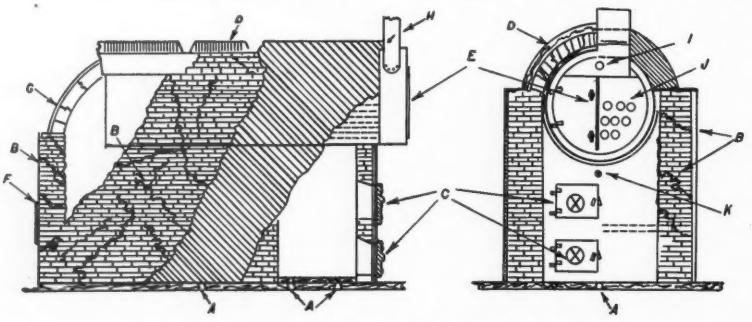


Fig. 1. Conventional horizontal return tubular boiler setting

Steel Encased Setting

In the diagram, Fig. 2, we show an all steel construction which on first glance might seem to be without combustion faults. There are, however, probably more owners of boilers in this general class wondering how they are going to meet fuel shortages than in any other. In this we refer to owners of apartment houses, small hotels and office buildings and all that class that lies in between the large boiler owner and the home owner.

This is not to disparage the use of this type for if properly sealed against air leaks it can be most efficient. One great trouble we have found was that many have been installed by general building contractors, who knew nothing of combustion needs, according to specifications drawn by men who knew but little more and often by parties who would not have had this important job except on price.

Too frequently, no reinforcement is put in the concrete floor other than that provided elsewhere. Thus, as shown at "S" we find cracks in the floor which let air under the concrete floor to come up into the furnace. These leaks are mighty hard to fix. In some cases the boiler is set on a brick base, but in more cases we find them set on a frame made up of I beams. More recent installations are better as welding can make tight seams at the corners of this I beam base, but on many we find the sections of the base merely bolted together, "Q," and no attempt made to seal the holes or to seal the seam where the furnace sets on the I beam, or "R" where the I beam rests on the floor. Then again we have found trouble at "P" where smoke pipe joins the collar of the breeching.

In a great many cases, probably the majority, on account of the fact that the installation is too small for employing a constant attendant, the fuel is oil. We have actually found cases where the leakage to "P" and "Q" and "R" at the rear was so great as to kill the draft and some "gopher" dug a hole in the concrete floor under the burner to allow more air to enter the firebox, thinking, if he thought at all, that the more air, the more draft. As a general rule, on the types of automatic oil burners used on these

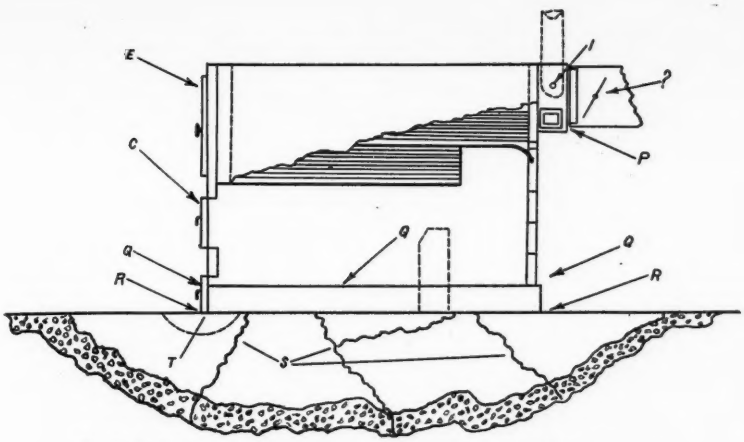


Fig. 2. Boiler in steel incased setting showing points where leaks may occur

boilers, especially in the smaller sizes, all air entering the furnace should come through the burner.

As in all boilers, the CO_2 sample should be taken after the gases have passed all tubes, "I."

It will be noted we mark the damper with a question mark (?). This represents one handicap for the unattended boiler, regardless of type. The National Fire Codes forbid dampers of other than authorized types which must bear the Underwriters seal of approval, on the unattended furnace, burning oil. This applies to homes as well as to larger buildings. There are many dampers on the market bearing the Underwriters seal of approval, but study that label. Does it say approved for unattended *oil fire*? The chances are it does not. It probably mentions coal or wood on which in most states no approval is needed, but it is very likely you could count all the dampers approved for unattended oil fire on one hand. On the attended fire one can do about as he pleases for he stops and starts the fire and knows the rules, so the authorized damper has to be a robot well drilled in safety first. Automatic control is not too expensive for this type, probably would pay for itself and the tightening of setting in one season, by the saving in the cost of fuel.

Settings for Water Tube Boilers

Figures 3 and 4 represent two types of water tube boilers. We find some with longitudinal drums, but more with cross drums which may be at either the front or rear. The breeching connection may be as we show, or on top, either at the front or rear. Where the drum is at the opposite end from the breeching, it is well to look carefully for air leaks.

In the matter of baffles, everyone who ever designed one of these types seems to have had different ideas from others, so while the types are found in the tens of thousands all over the country, and in a large variety of capacities, our sketches are only schematic and represent no particular make.

It is safe to say that if 50 per cent of such boilers in operation daily in single units or in batteries were brought to within 85 per cent of their possible maximum efficiency, which is easy to attain, *there would be no fuel shortage.*

Lettered details are about the same as in Fig. 1, from "A" to "K" inclusive and faults are the same, we add, however, "L" the pipe through brick wall. Possibly a 4 in. hole for a 2 in. pipe and we have found the surrounding space open or plugged with asbestos wool.

We again show "I" as the place to take the Orsat sample, the flue gas temperature and stack draft, but referring back to our mention of sample taken through "peep hole" we show a common fault in a hole drilled through the cover of the peep hole or manhole, for sample, and of course far from direct line of the flue gas stream.

In Fig. 4 we show a theoretical gas temperature distribution in a tight boiler, but if air leaks show at or near upper or lower "B", the CO_2 sample would be off and flue gas temperature may be seriously affected. We found a case something like this with low CO_2 and low flue gas temperature. Steaming was poor, but taking the low flue gas temperature as their criterion the fire was forced, damaging the furnace lining and injuring the tubes. Here the fireman blamed the trouble on an endeavor to bring up the CO_2, but when the leaks were found and sealed all trouble ceased. Undoubtably it is cases like this that makes some claim that high CO_2 is fine but hard on the boiler. The CO_2 is not at fault. Repair the leaks and the CO_2 will take care of itself. Here also we find the reason for keeping the baffles in good condition for, as in Fig. 4, if baffles break down, flues will not get complete contact with hot gases.

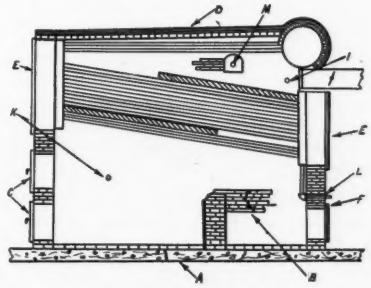


Fig. 3. Cross-drum water tube boiler showing vulnerable points in setting

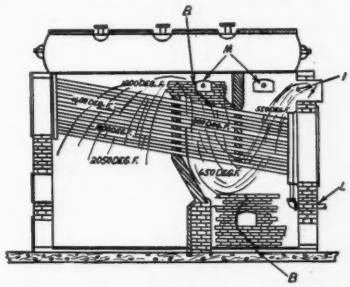


Fig. 4. Longitudinal-drum water tube boiler setting with normal temperature distribution indicated

Inclined Tube Draft Gage

One thing we have never been able to understand is why firms installing small, medium, or even fairly large boilers do not include in the equipment a draft gage installed for the operators guidance. Possibly it is because too much stress has been placed on elaborate equipment.

On large jobs we usually find multiple section draft gages, so connected that the operator can ascertain at a glance his under fire, over fire, first pass, second pass and uptake drafts, or in more modest jobs the under fire, over fire and last pass drafts, while others may be so complete as to require a dozen or more sections.

Then, if anything goes wrong, anywhere, the records of the daily or shift log locate the defect and its progress. Then when the time comes that repairs are possible the engineers know right where the trouble lies, but on the small boiler, or any boiler without draft gages,

(*Continued on Page* 136)

Distributing Electric Power the Nebraska Way

A major portion of the state of Nebraska is now served by a non-profit organization which, through many local divisions, distributes electric power to customers who are assured that no financial organization can profit by the manipulation of rates. Consumers is financed by the sale of bonds to privately owned organizations, and bonds are being paid out of earnings, rates adjusted for self support

By John Hoge *General Superintendent*
Consumers Public Power District

HERE IN Nebraska is public ownership of the electric industry operating in a manner entirely unique as a public enterprise in the United States.

Consumers Public Power District was organized under Senate File 310, commonly referred to as the Enabling Act, which was passed by the Nebraska Legislature in 1933 and provided for the organization and operation of public power districts in Nebraska. Under this same bill the Loup River Public Power District, the Platte Valley Public Power and Irrigation District, the Central Nebraska Public Power and Irrigation District and all of the REA Districts in Nebraska were organized. Unlike the other public power districts in Nebraska, which were financed by funds supplied by the Federal Government, Consumers Public Power District received no United States Government money, but was financed by funds obtained through the sale of Revenue Bonds to banks, insurance companies and other private interests.

Consumers Public Power District was originally organized to purchase the distribution system in Columbus, Neb., from the Northwestern Public Service Co. of Huron, S. D. by a lease purchase agreement and later in July of 1940 this property was purchased outright by the issuance of Revenue Bonds in an amount equal to the purchase price. At that time there was probably little thought that Consumers Public Power District would be more than a local concern.

The Southern Nebraska Power Co. with headquarters in Superior, however, was in poor financial condition and ripe for purchase. By this time all three of the large hydros were in operation. It was, therefore, decided that Consumers would purchase the Southern Nebraska Power Co. under the organization already perfected and then lease the property to the Central Nebraska Public Power and Irrigation District. This was done in October of 1940.

At the same time the Northwestern Public Service Co. had another property at North Platte which was also for sale. It was decided to buy this property and this was done later that same month, but in this case the property was leased to the City of North Platte.

For several years prior to this time, there had been negotiations going on looking to a purchase of the larger power companies by the "Hydro Pool" a combination of three large Hydro Districts. The idea was to coordinate the whole and thus provide a market for the hydro-electric energy generated by the three large hydro plants in the state. This idea was finally abandoned.

In the meantime, Consumers Public Power District had become a going concern and able to finance the purchase of these same properties. For that reason it was immediately expanded. The Elkhorn Valley Power Co. properties in Nebraska were purchased.

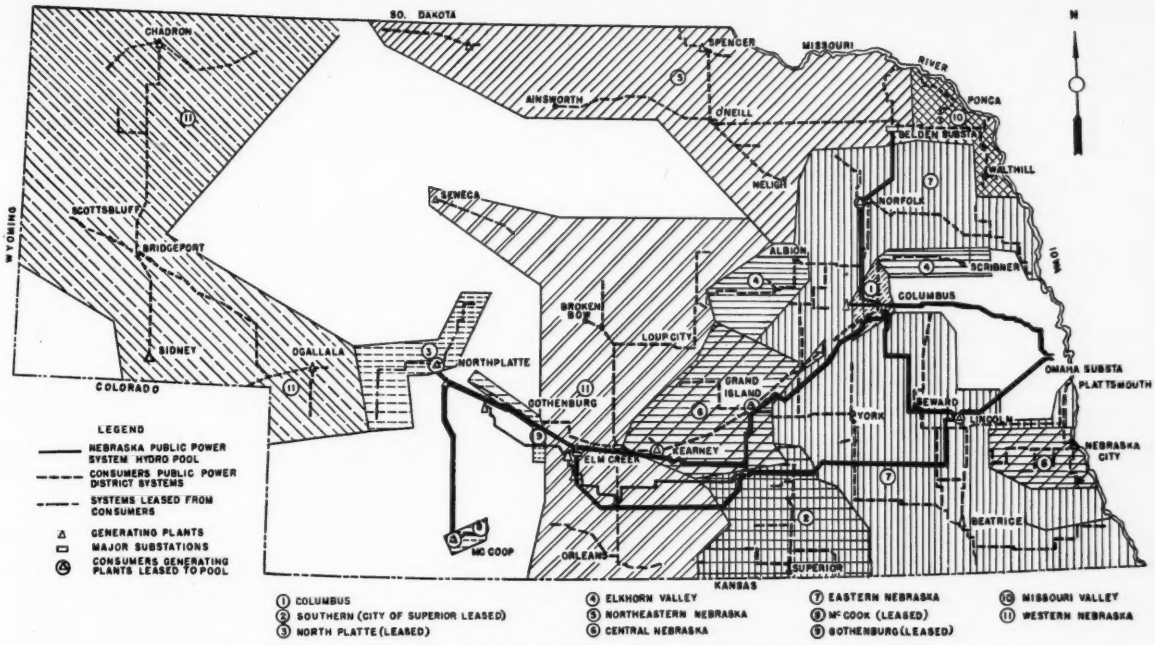
By this time it had been decided that Consumers should operate these properties with headquarters at Columbus, the present Board being resident of Columbus. For that reason no effort was made to lease these properties. In December of 1940 negotiations were completed for the sale of the Central Power Co. and the transfer completed early in January of 1941. At this time the former officers of the Central Power Co. were transferred from Grand Island to Columbus and put in charge of operations of all of the properties of Consumers not under lease since this was the first company taken over with management personnel.

In April of 1941 the Iowa-Nebraska Light and Power Co.'s Nebraska electric holdings were purchased and included was the Gage County Electric Co. of Beatrice. That same month the McCook and Gothenburg properties were acquired. These latter were at once leased to the Platte Valley Public Power and Irrigation District for operation as at that time Consumers had no property in the western part of the state.

In July the Nebraska Public Service Co. was purchased and made the Missouri Valley Division and in January of 1942 the Western Public Service Co. was purchased, completing the ownership of practically all the former power companies of the state with the exception of the Nebraska Power Co. operating in Omaha and vicinity. So much for history and properties acquired.

Bond Issues

Now, it should be borne in mind that for each of these purchases there were separate bond issues and that each of the bond issues was sold to a different group of investors. In each case the bonds are revenue bonds and cover periods from 25 to 30 yr. They are so issued that Consumers must pay the interest and retire certain bonds yearly, much as a building and loan company retires the purchase price of property. In this way the interest and principal payments taken together represent an approximately fixed amount for the life of the bonds.



Map of Nebraska indicating location of various divisions of Consumers Public Power District

For the reasons stated above (namely, each purchase represents an independent bond issue) it is necessary that each property covered by a separate bond issue be operated independently and a complete set of books and records be maintained for each. At present Consumers operates directly eight divisions:

1. The Central Nebraska (Central Power Co.)
2. Columbus (City of Columbus, original property).
3. Eastern Nebraska (Iowa-Nebraska Light and Power Co. and Gage County Electric Co.)
4. Elkhorn Valley (Elkhorn Valley Power Co.)
5. Missouri Valley (Nebraska Public Service Co. and Central States Electric Co.)
6. Northeastern Nebraska (Interstate Power Co.)
7. Southern Nebraska (Southern Nebraska Power Co.)
8. Western Nebraska (Western Public Service Co.)

The Central Nebraska Public Power and Irrigation District returned the Southern Nebraska Division to Consumers early in 1942 and the lease was cancelled.

In addition Consumers owns and leases three divisions namely:

1. City of North Platte
2. Gothenburg Division
3. McCook Division

It probably should be noted now that at the time of purchase Consumers leased the steam plants owned by the Eastern Division at Lincoln and Norfolk to the "Hydro Pool" and soon thereafter leased the steam plant near Grand Island and the Kearney Hydro-Diesel plant of the Central Division to the "Hydro Pool." In return for this the Pool gave Consumers certain demand credits on power contracts to the respective divisions. This arrangement was entered into in order that the Pool would be the central generating agency and Consumers the distributing agency. For that reason Consumers purchases about 80 per cent of its energy requirements, the remainder being generated in small hydro plants or in Diesel and steam plants used only for emergency or voltage control.

The one exception is the steam plant at Scottsbluff. This part of the system is not connected to the Hydro Pool and for that reason the plant at Scottsbluff is a base load point. Some energy for this system, however, is purchased from the Reclamation Service Hydro Plant at Guernsey, Wyo.

As stated before, each of the divisions is operated as a separate unit. That is to say no property can be transferred from one division to another division without purchase contracts in the same manner as though a sale had taken place between two entirely separate companies. In the same way when power is being transferred between divisions, it must be metered and sold by the seller to the buyer in exactly the same manner as though the two divisions were independent companies. Where a bill is rendered by a supplier such a bill may be for material sold to all eight divisions, but for each division a separate voucher must be made to cover only the material purchased by that division.

Anyone familiar with operating problems will realize that all of the above complicates the operation and adds to the burdens of accounting and management. This is particularly true as the largest division has a monthly revenue of about $300,000 and the smallest only about $8,000.

In 1942 a new building was built at Columbus where the General Office of Consumers is located. Columbus was selected as the home office because it was the home of the original division, but it should also be noted that it is geographically well suited as headquarters for Consumers. A study of the map discloses that Columbus is centrally located for all of the Eastern Division, including even a portion of the Western Division, and only the western part of the Western Division is at a distance from Columbus. Seventy-five per cent of the total revenue is from the eastern section and in a large

measure the operating problems are here.

At Columbus is located the General Manager (V. M. Johnson) and his staff, including the operating, insurance, rate, new business and personnel departments, and the accounting and billing departments are housed in the new building. Here, too, is the controller who supervises the budget and the Board of Directors hold a weekly meeting. The one exception is that for the Western Division the accounting, engineering and billing are done at Scottsbluff.

As now constituted, Consumers is largely operated by "districts". Each district has a manager and operating personnel reporting to him. He, in turn, reports directly to the General Manager. District department heads are guided by the department heads in the General Office, who give general supervision. In some cases a whole division is a "district". In others the division is divided into a number of districts. (For instance, the Eastern Division is divided into five districts.)

Anyone familiar with utility operation will understand that to weld fourteen companies together into an operating unit requires time and patience. Great effort has been made to keep the operation as smooth as possible so as not to disrupt any of the parts. Where some organization has had a good plan or method it has been adopted. For that reason each unit has been allowed to operate much as it did when in private hands only such changes being made as were absolutely necessary in order to carry on the operations. There is yet much to do, but in spite of the added difficulties due to the war, a good beginning has been made and all divisions are rendering good service and meeting obligations. In many, substantial rate reductions have been made and it is hoped that these may be continued as greater economies of operation are effected.

Consumers is a "non-profit organization". All surplus, over and above that needed for replacements and betterments, must be returned to the customers in the form of rate reductions. At the same time, the property must be kept in repair and new extensions made as required. All of this must come out of earnings. The problem of management is to meet these various requirements, knit the various units into an operating whole and, at the same time, give the customers, who in this case are the owners, satisfactory service at the lowest possible cost.

New Invisible "Raincoat"

AN INVISIBLE "raincoat" which can be formed on cloth, paper and many other materials by exposing them to chemical vapors from a new compound, thereby making them water-repellent, has been developed in General Electric's Research Laboratory at Schenectady, N. Y., by Dr. Winton I. Patnode.

Called Dri-Film by the G.E. Electronics Department which will market the new compound, one of its most important uses so far is the treatment of ceramic insulators for radio equipment being made for the armed forces of the United States. It is about nine times more effective than the wax used at present as a water repellent and its results are permanent.

Dri-Film is a clear liquid composed of various chemicals which vaporize at a temperature below 100 C. Articles to be treated are exposed, in a closed cabinet, to the vapors for a few minutes. Then they are taken out and, if necessary, are exposed to ammonia vapor. This is to neutralize corrosive acids which may collect during treatment.

Dr. Patnode is not able to explain exactly what happens in the process, but the result is that an extremely thin film is formed on the surface. This "raincoat" is so thin that its structure cannot be determined by chemical analysis. It cannot be seen under a high-powered microscope.

Probably the biggest use of ceramic forms today is in radio communications equipment where high electrical resistance between conductors is absolutely essential to successful performance, according to E. E. Williams, G.E. electronics engineer. "These ceramic insulators, when dry, provide extremely high electrical resistance. However, in service one of the adverse conditions frequently met has been condensation of moisture on the surfaces of the ceramic forms. Such condensation, if not controlled, forms a film of water and reduces the resistance between conductors to the point where excessive leakage of current results, and the performance of the equipment is impaired. Consequently, manufacturers have for years treated ceramic parts, built into this type of apparatus, with materials which to a greater or less degree reduce the effects of condensation. In the past, the best methods of treating these parts have been varnishing and waxing. Searching for a better and more effective method, Dr. Patnode developed the new and radically different treating material.

G.E. Research Laboratory tests show the wide difference in the water-repellent characteristics of ceramic surfaces when glazed or treated with wax, and with the new compound. These tests were made under conditions of temperature and humidity similar to those met by military forces in service from the arctic to the tropics. Tests of surface resistivity (a measure of resistance) were made on a number of closely controlled specimens which had been subjected to the condition of 100 per cent relative humidity at 25 C with the ceramic parts precooled below the dew point. A value of 100 was arbitrarily assigned to the surface resistivity of unglazed ceramics that had been treated with wax. On the same basis of evaluation, parts treated with Dri-Film were found to have a surface resistivity of 870.

"In addition to providing a high initial surface resistivity, the water-repellent treatment for ceramics must be able to withstand heat, handling, and cleaning," Mr. Williams explains. "It should not increase the tendency of the surface to accumulate dust. Dri-Film, after application, is not adversely affected by heat up to 300 C applied for short intervals. It is not susceptible to abrasion as the result of handling during assembly of apparatus or field maintenance. Finger prints and other dirt smudges can be easily removed from Dri-Film treated ceramics with a cloth or brush moistened with solvent."

Another use for the new compound is a laboratory one. The surface of water in laboratory glassware, such as measuring cylinders and hydrometers, is ordinarily curved, low in the center, because the liquid wets the walls and tries to climb up them. Such a curved surface, or "meniscus," is prevented if the inside of the container is treated with the waterproofing vapors from Dri-Film. Then the water surface is flat and its height may be read more easily.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

GIVE US ALL THE FACTS

Several days ago we received a letter from one of our good readers in which he asked for advice. He was having trouble with his wood burning boiler. It was a low pressure job, burning Douglas Fir second growth cordwood and his trouble was with the soot and creosote that formed on the tubes. This deposit, he said, adhered to the tubes like gum. The boiler was kept on the line practically day and night but some time ago he had an opportunity to clean the boiler and he thought his troubles might be over for a while. In two days' time, however, the boiler was as dirty as though he had not cleaned it for a month. The condition seemed to be aggravated before a storm. He wanted to know what to do, could we tell him how to set his dampers or was there some compound he could burn in the firebox that would prevent the formation of soot. These were all the facts he gave.

This certainly is a legitimate question and we would like to help him out but our purpose in mentioning the matter here is that he gave us so very little data to work with. If he had told us a little more about his boiler, sent us a sketch of the furnace and some information regarding its construction as well as more data on his fuel we could have given him a very much more satisfactory answer. As it was, we could only guess and our answer had to be of a rather general nature. The point is, that this question is not an exception; we receive many requests for advice which contain very little data on which to base a satisfactory answer. So, to those of you who have problems, please keep in mind that the more information you give about these problems the more will it be possible to provide you with a satisfactory reply. We like to be of help but we need a reasonable amount of data to work with.

—A.W.K.

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How To Interchange Voltmeters and Ammeters

By Lt. Eugene G. Key

Here is a valuable article that will enable any electrician to get increased use out of the electrical instruments available to him and may help him out of a difficult situation in time of emergency. It is quite generally known that ammeters may be used as voltmeters, and voltmeters as ammeters, by the proper use of resistances but often knowledge in regard to actually making the measurements is hazy. In this article, Lt. Key presents the simple facts regarding the use of instruments for various types of measurement in a way that anyone can easily understand. Lt. Key, by the way is our old friend Eugene Key whose contributions on electrical subjects used to appear in these pages quite regularly. He is now in the army with the Air Service Command

THERE ARE TIMES when electricians or other shop men want to make tests on equipment and find that the meters on hand are not adequate for the job. They may desire current readings and find that only a voltmeter is available or voltage readings when only an ammeter is on hand. Sometimes an ammeter or a voltmeter is not of the required capacity for the test desired.

Since meters are very expensive, a company may not feel justified in buying enough meters for every test that can be made. However, for a comparatively small cost, shunts or resistors may be made or purchased which will make any ammeter or voltmeter available for testing circuits ordinarily beyond the designed capacity of the meter without overloading the meter.

I. Using a Voltmeter as an Ammeter

Voltmeters are designed to be connected across the line and are, consequently, wound with small wire and have high resistances. To connect them in series with the line like an ordinary ammeter would either cause such a high voltage drop that the equipment could not operate or the current would burn up the voltmeter. Accordingly, a resistance of some sort should be placed in the line and the voltmeter connected across it as shown in Fig. 1. The reading of the voltmeter is then proportional to the current flowing through the shunt, R, and is expressed:

$$\frac{I_v}{I_r} = \frac{R}{R_v} \qquad (1)$$

where I_v and I_r are the currents in voltmeter and shunt, and R_v and R are their respective resistances. The current in the line L is then:

$$I_L = I_v + I_r \qquad (2)$$

Solving (1) for R:

$$R = \frac{I_v R_v}{I_r} \qquad (3)$$

Most voltmeters are designed so that the resistance of their windings is from 30 to 100 (or more) ohms per volt. The actual value is printed on the scale or some other part of the instrument or its case. An average value from a cost standpoint (the lower the resistance per volt the lower the cost) might be 50 ohms per volt. If the scale is 300 v, the meter would have a total resistance of 15,000 ohms.

In using a voltmeter as an ammeter, one important fact must be noted: the voltage drop in the shunt R must be kept low or the terminal voltage of the load will be too low for even test operation.

Most portable voltmeters have three or more scales. The voltmeter already

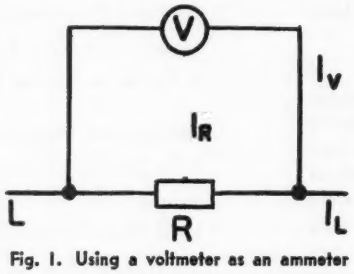


Fig. 1. Using a voltmeter as an ammeter

mentioned, then, will probably have a 150-v and a 75-v scale in addition to the 300. Four divisions of the 75-v scale equals one on the 300-v scale. The total resistance of the winding for this scale would then be 3750 ohms. During a test a five per cent voltage drop across R might be allowed. For a 210-v system, the drop could be, then, 21 v, or, better, 20 v. If a maximum of 20 amp could be expected to be drawn by the load, R would then be:

$$R = \frac{V}{I_r} \qquad (5)$$

$$R = \frac{20}{20} = 1 \text{ ohm} \qquad (A)$$

where V is the voltage drop across the shunt.

The current drawn by the voltmeter for this value of R is:

$$I_v = \frac{V}{R_v} \qquad (6)$$

$$I_v = \frac{20}{3750} = \frac{2}{375} \text{ amp} \qquad (B)$$

Obviously, this current is negligible and can be neglected in all calculations. Then, from equation (2), if I_v is zero or nearly so:

$$I_L = I_r \qquad (7)$$

V is the voltmeter reading, so that 20 v on the voltmeter scale will indicate 20 amp load current for the value of R chosen. Since 20 v on the 75-v scale equals 80 v on the 300-v scale, a good current reading may be obtained. The shunt thus calculated can be used for any current reading of 20 amp or less, but never more than 20.

Since a five per cent drop was assumed, the voltage across the load during a test of this kind is only 95 per cent of the rated voltage. This drop may not be serious in a motor circuit, but can be corrected for, approximately, by adding five per cent to the measured current. The true I_L under normal operations would then be 21 amp. A five per cent error in the reading is not to be considered serious, however, if the correction is small, as the error would be within the designed accuracy of nearly any meter.

In designing the shunt, R, care should be taken that it is large enough in cross-sectional area of the wire to carry the full load current. Tables of wire sizes should be consulted.

II. Using an Ammeter as a Voltmeter

Ammeters are designed with large wire and very low resistances for a low voltage drop. Fig. 2 shows how an ammeter should be connected to read voltage. If E is the voltage corresponding to the full-scale reading of the ammeter, R the resistance in series with it, and I the current required for full-scale reading of the ammeter, then:

$$E = I(R + R_a) \qquad (8)$$

Solving (8) for the unknown R:

$$R = \frac{E - IR_a}{I_a} \qquad (9)$$

The resistance of the ammeter is sometimes given on the instrument case. If the voltage drop is given, however, R_a may be calculated:

$$R_a = \frac{V_a}{I} \qquad (10)$$

where V_a is the given voltage drop through the ammeter and I is still the full-scale reading of the meter.

A fair value of drop through an ammeter is 0.2 v. If the full-scale current I is 5 amp, R_a is found from (10):

$$R_a = \frac{0.2}{5} = 0.04 \text{ ohms} \qquad (C)$$

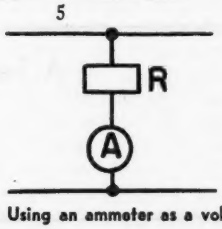


Fig. 2. Using an ammeter as a voltmeter

The voltage to be measured may be estimated or known to be about 250 v. A good reading of voltage may be obtained if the indication is from one-half to two-thirds of the full-scale reading. If 500 is to be considered as the line-to-line voltage for full-scale reading, then, from (9):

$$R = \frac{500 - 0.2}{5} = 99.96 \text{ ohms} \quad (D)$$

If the voltage drop through the meter is less than one per cent of the selected value of E, it may be neglected. Then R becomes:

$$R = \frac{500}{5} = 100 \text{ ohms} \quad (E)$$

If E is the voltage corresponding to full-scale reading of the ammeter in amperes, the actual reading, S, of the ammeter in amperes would be (with the value of R connected as shown in Fig. 2):

$$S = \frac{100I}{E} \quad (11)$$

$$S = \frac{(100)(5)}{500} = 1 \text{ amp. for } 100 \text{ v} \quad (F)$$

That is, one ampere on the ammeter scale equals 100 v in line-to-line voltage.

III. Using a Voltmeter for Measuring Higher Voltages

A voltmeter can be used to measure voltages higher than its design permits if the connection shown in Fig. 2 is used with the voltmeter in place of the ammeter. Substituting R_v (the resistance of the voltmeter) for R_a in equation (9) gives the value of the resistance R which should be used:

$$R = \frac{E - IR_v}{I_v} \quad (12)$$

In equation (12), E is the desired value of the full-scale reading of the voltmeter to be used, and I is the current required for full-scale deflection of the voltmeter. This current I is:

$$I = \frac{F}{R_v} \quad (13)$$

where F is the designed full-scale voltage of the voltmeter and R_v the resistance of the meter.

The voltmeter mentioned in the example of part I has 15,000 ohms for a full-scale reading of 300 v. If it is to be used on 440 v, the value of E could be about 600 v. A convenient conversion would be to let the 300 v on the actual scale be considered as reading 600 v when used with the proper value of R. In equation (12), IR_v is the actual full-scale reading of the voltmeter. If this scale is to be used to represent 600 v, equation (12) gives the value of R:

$$R = \frac{600 - 300}{0.02} = 15{,}000 \text{ ohms} \quad (G)$$

With this value of R inserted, the voltmeter can be used safely on systems up to 600 v.

IV. Using an Ammeter on Higher Currents

By using the connection shown in Fig. 1, an ammeter can measure higher currents than those for which it is designed if the proper shunt, R, is used. A relationship similar to that of equations (1) and (2) again applies:

$$R = \frac{I_a R_a}{I_r} \quad (14)$$

where $I_a R_a$ is the voltage drop through the ammeter for full-scale deflection and I_r is the current through the shunt, equal to:

$$I_r = I_1 - I_a \quad (15)$$

I_a is the full-scale reading of the ammeter and I_1 is the load current required for I_a at the proper value of R.

In part II, the ammeter had a full-scale reading of five amperes and a voltage drop of 0.2 v. If the ammeter is to be used to measure up to 30 amp, equation (1) gives as a value for the current in the shunt:

$$I_r = 30 - 5 = 25 \text{ amp} \quad (H)$$

and:

$$R = \frac{0.2}{25} = 0.008 \text{ ohms} \quad (I)$$

The ammeter will then read:

$$S = \frac{I_1}{I_a} \quad (16)$$

$$S = \frac{30}{5} = 6 \quad (J)$$

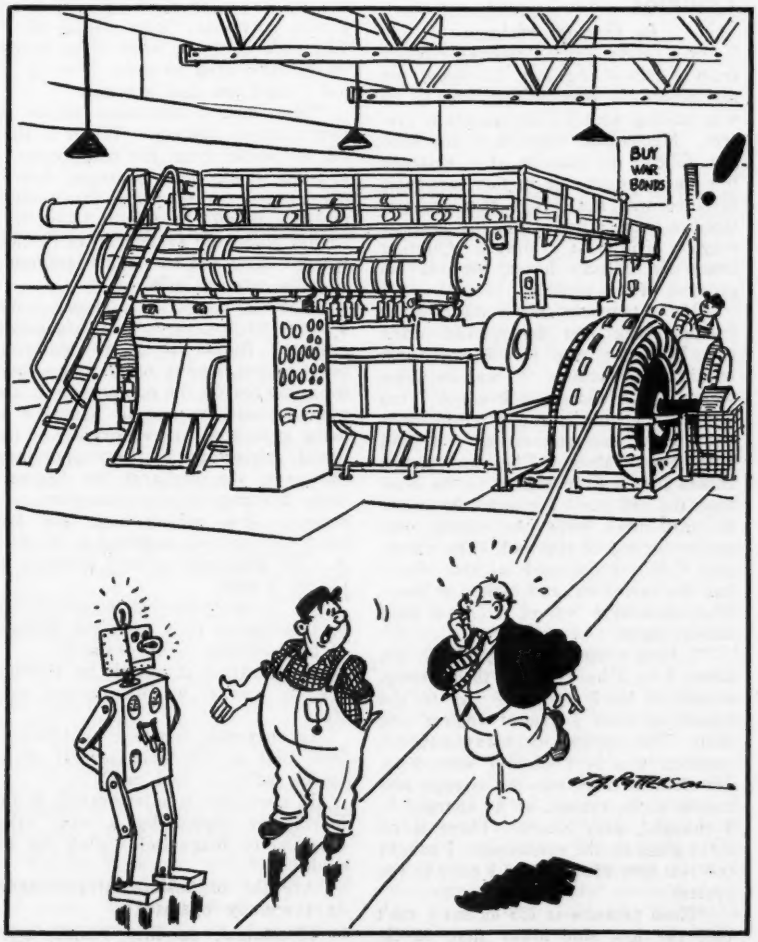
V. Notes on the Connections Described

1. In parts I and II assumptions were made for the use of equations (3) and (9)—see calculations (B), (D) and (E) and the accompanying explanations. These assumptions are not to be used in any calculations for parts III or IV.

2. Values assumed for I_1 in parts I and IV and for E in parts II and III should always be higher than the values actually expected. The safest values to assume are those which will allow most of the readings to be taken to cause half to two-thirds of the full-scale deflection of the meter. Approximations of I_1 and E may be made from name-plate data on equipment to be tested.

3. All resistors and shunts made from calculations in parts I, II, III and IV should be portable and should be disconnected after making the tests. They should be stored in safe places and marked for easy identification. These marks should include the number of the meter with which it is to be used, the conversion constant (change from the actual meter scale) and, usually, current capacity of the shunt.

4. All equations and calculations given in this article may be used with either or one ampere on the true scale will indicate 6 amp flowing in the load circuit.



"Think we'd better take him, boss? He's the only one that answered our 'help-wanted' ad."

a-c or d-c meters, but the resistors and shunts should be wound non-inductively for alternating current.

5. Some meters are made with two or more scales and the voltage drop in the resistance of every winding is then given on the case. A resistor or shunt determined from the equations given in this article can be used with only the scale for which it is made unless its effect on other scale readings is also known from the proper calculations. Enough information is given in this article so that these calculations may be made.

6. Sometimes, instead of using a resistance calculated from part III to measure voltages beyond the range of the voltmeter, two voltmeters can be connected in series. The total voltage is the sum of the readings on the two meters but the readings may not be equal on the two meters. Suppose a 30-ohms-per-volt meter is used with a 50-ohms-per-volt meter but both meters have 300-v scales. The 30-ohms-per-volt meter will have a resistance of 9000 ohms. If they are connected in series on a 440-v system, their readings will be IR_1 and IR_2, where I is the current flowing through both meters and R_1 and R_2 are the respective resistances of the meters. The total resistance is 15,000 plus 9000 ohms, or 24,000 ohms. On 440-v, the current I is 0.01833 amp. Their actual readings will then be:

9000-ohm meter:
(0.01833) (9000) = 165 v
15,000-ohm meter:
(0.01833) (15,000) = 275 v

The total readings is then 440 v. It should be noted that the higher resistance meter reaches its maximum more quickly than the other. The highest voltage readable with this combination is, for this reason, 480 v, as this meter will then read 300 v and the other only 180 v.

7. Portable voltmeters and ammeters often come equipped with leads designed for the meters themselves. The resistance of these leads is included in the values given on the meter or its case and should always be used with their correct meter for accurate readings. Although a small variation in resistance may have only a negligible effect on voltmeter readings, even a small variation will affect ammeter readings. If the leads become injured so that they must be replaced, they should be purchased from the manufacturer or duplicated as nearly as possible in the shop.

Analyzing Refrigerating Troubles

By George Holman

IN A LETTER which I received recently from a fellow engineer, he asked me for advice in overcoming trouble he was having with his refrigeration system. Mechanical troubles of any kind are difficult to analyze at a distance but since the trouble in this particular instance was not unlike that encountered in many other plants, my analysis may be of interest to others. Quoting from my friend's letter, here is his account of the trouble.

"My 5-ton ammonia compressor is frosting back over the cylinder walls and I cannot stop it. I have just rebuilt this machine. It was so noisy when I took charge of it about 7 mo ago that I put in a new crankshaft, one piston and connecting rod, and both head valves. The new piston comes just a little higher in the bore than the old one. I ground the heads in until they were the whole way across the top of the wall. The valves seat O.K. I am sure of that for I had the valves out and looked at them. The expansion valves I have shut almost tight.

"I have a tank freezing 450 lb ice, about 5 by 5 by 4 ft, and three refrigerators 4 by 7 by 8 ft. As to the length of coils I cannot answer you that. The compressor manufacturer's engineer was here when I started up. He claimed there was not enough ammonia in the system, so he charged it, I thought, very heavy. There is no sight glass on the condenser. I cannot tell you how much liquid I have in the system.

"Head pressure is 135 lb, but I can't pull the low side lower than 35 lb. There is no heat from the exhaust of the compressor to the condenser, so I am at a loss to figure this one. I have the ice boxes shut off tight and am getting anywhere from 32 to 45 F. The tank does not want to go below 18 F. We used to carry it at 10 F, but I can't get that low now.

"How does a compressor act on an over-charged system? When I shut off the water from the compressor I can get more head pressure, but it does not seem to bring the suction pressure down. I do not know if I should pump the system down or not, when I can't tell how much ammonia is in the receiver."—W. G.

In itself, high suction pressure is not a cause of trouble in a refrigeration system. Rather it is an indicator, pointing out, among other things, that for some reason the compressor is not pumping out the gas as fast as it is being generated by evaporation of the liquid refrigerant in the evaporators. Whenever the discharge line becomes cold, frosting of the compressor is serious. But neither high nor low head pressure has anything to do with it. For ammonia, a head pressure of 135 psi is ideal.

W. G. omits several important factors necessary to a complete analysis of his problem. For example:

Is operation automatic by thermostat or manual by push-button control?

Is operation constant or intermittent, that is, are there several off-on cycles daily, or just one?

If operation is intermittent, is the liquid line closed by a stop valve (manual or magnetic) during the off cycle?

Are the expansion valves manual or thermally operated?

If manual, do they remain open when the compressor is idle?

Is there a float regulator in the system, either as a master liquid level controller or only as an expansion valve for the tank coils?

What is the temperature of the water entering and leaving the condenser during the operating cycle?

What is the difference between the head pressure during the off cycle and the head pressure when the compressor is operating?

To what figure does the suction pressure rise during the off cycle?

Can the system be pumped down to zero suction (back) by closing the master (king) liquid valve on the line from the condenser?

"Frosting back" along the return line of a refrigeration system may be due to very cold gas, such as that from evaporators in freezers or other very cold refrigerators, flowing back to the compressor. When the cold rooms are 30 deg or above, and even when they are much colder, frosting is due to liquid refrigerant still "expanding" after failing to evaporate during its passage through the evaporator, or coils. When the quantity of this liquid is excessive, it not only takes up the heat of friction of the operating compressor; it also draws heat from the atmosphere, condensing the moisture of the air and freezing it to the outside of the cylinders.

Often the discharge, or "hot gas" line leading from the compressor to the condenser, gets cold. In extreme cases, the compressor may "flood" or "prime." This is accompanied by slamming of the discharge valves, unless they are of the feather type, and the safety heads may pound. In all cases—*bar none*—frosting of the cylinders is due to at least one of the expansion valves of the system admitting more liquid refrigerant than the evaporator it is feeding can evaporate. It may be opened too widely while the compressor is running; it may be leaking; or it may have been left open to admit liquid while the compressor was idle.

Overcharging a system always results in a very noticeable rise in the discharge pressure during the operating cycle. On any system, the discharge pressure will rise whenever the compressor starts. But when the system is overcharged this rise becomes much more than it should be, and may reach 50 psi or more. This is due to the simple fact that an oversupply of refrigerant in a normally operating system always collects as a liquid in the condenser.

Even if there is a separate liquid receiver, the liquid will rise into the condenser and cut off so much of the heat transfer surface of the tubes that gas enters the smaller gas space of the condenser faster than it can be condensed by the water. As long as the compressor continues to discharge the same quantity of gas into this smaller-growing space, the head pressure will continue to rise and may reach dangerous figures, if water temperature is high.

My advice to W. G. is to close the master (king) valve leading from the (I assume) combined condenser-receiver and attempt a pumpdown of his system "at once and without delay." There is absolutely no danger in doing this, even though the charge in the system is unknown, provided the gages are watched closely and the compressor shut down if the head pressure rises too high.

Pumpdown should take no longer than two hours, if the system is average in volume and moderate in charge, and the compressor is in order. If the system is overcharged, the head pressure will rise slowly, higher than its usual operating figure, and will reach a maximum at about the time the suction pressure falls to 10 psi. Due to the lesser quantity of gas being delivered at each stroke of the compressor, the head pressure should remain constant for a time. Then as the suction falls to zero or below, the head pressure should drop back almost to its off-cycle value.

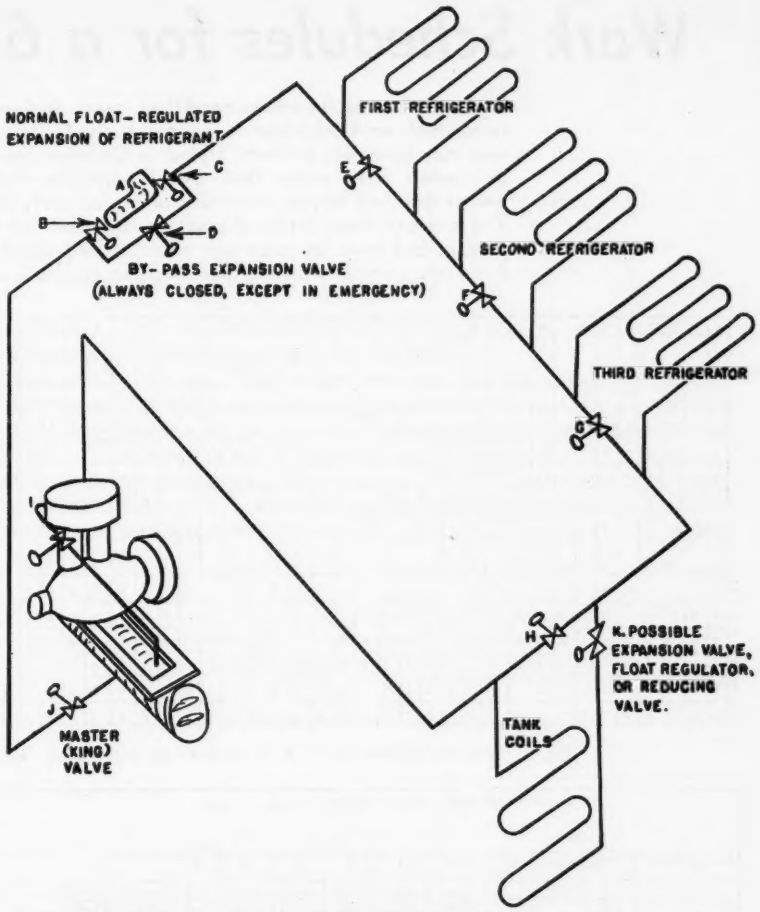
If the system can be pumped down to zero or below, there is nothing wrong with the compressor. If it can't be pumped down, one or more of three things is wrong with the compressor. A discharge valve is sticking open; a suction valve is sticking open; or there is considerable blowby of gas past the pistons and rings. However, I feel sure that if there was anything wrong with the compressor, W. G. is mechanic enough to recognize and fix it.

One passage in W. G.'s letter strikes me as significant. He says, "I have the ice boxes shut off tight and am getting anywhere from 32 to 45 deg." If these boxes are cut off the system, what keeps them cool? Surely, the temperatures in them should rise if they are really cut off. All refrigeration valves are standard, turning clockwise (to the right) to close. If W. G. has turned them to the left until they are backseated, this would explain both the high suction pressure and the flooding of the compressor, as the valves would then be wide open.

I can't quite picture W. G. not knowing how a standard valve opens and closes. For this reason his assertion of an obviously impossible condition—that the boxes are being kept cold with the valves closed—leads me to believe that he has a "flooded bypass" system of coolers in series.

This system is sometimes used when there are a number of coolers any one of which is too small for a separate expansion valve to feed. I occasionally service a system of this type containing an 8 by 18 ft chill room, a 12 by 16 ft storage room in which the lone thermostat is placed, three boxes of about the size of those described in W. G.'s question and a sharp freezer whose evaporator is fed through a reducing valve.

The accompanying sketch shows how such a system might be applied to W. G.'s refrigerators and freezing



Holman's sketch of a flooded system showing evaporators in series. When working at capacity, valves E, F, G and H should be closed tight, forcing refrigerant to pass through every coil in series. If any cooler gets too cold, valve opposite it is opened, not closed

tank. It requires a heavier charge than the dry system in common use. There is only one expansion valve in the system. Expansion is by means of a float regulator, with a by-pass expansion valve on a line around it for use in an emergency, as shown at A and D of the sketch. Leakage past the seat in this regulator will bring about the flooding and high suction pressure W. G. complains of. Likewise, if the float has filled and sunk, the same results will be produced.

To check on this regulator, if present, close the valves B and C above and below it, and open the by-pass expansion valve D not more than one-third turn. If the suction pressure falls and the flooding ceases, W. G. should remove the regulator and ship it to the factory for overhaul. During this time he can use the bypass valve D for expansion, taking care not to open it too widely. If this valve is even partly open while the regulator is in service the conditions described by W. G. might occur.

Valves E, F, G and H are not expansion valves in the true sense of the term. In effect, they operate in exact reverse to a standard expansion valve. For example, closing the valve E does not cut off the first refrigerator. Instead, it prevents the refrigerant from taking the short cut past the cooler and forces it to rise into the evaporator. Therefore tight closing of this valve forces the evaporator to work at capacity. If W. G.'s system is of this type, and if he has tightly closed valves E. F and G, while opening valve H in an effort to lower the tank temperature, he will have done the exact opposite of what he should have done to a system like this. The overall results would be the exact opposite to what he might expect.

The supposition that W. G.'s system is of the flooded type I base on his assertions about the heavy charge and the refrigerators remaining cold when apparently "cut off." A rough sketch of his system might enable me to be more specific in pointing out what is wrong. Valves and regulators, especially, should be shown. However, if W. G. will try a pumpdown and check on the regulator, if present, as above detailed, I feel sure that he will locate his trouble. On my first visit to the storage plant I mentioned, the operator claimed there was no regulator, and was convinced only when I climbed upon a baffle and pointed it out to him.

Work Schedules for a 6-Day Week

Because of present wartime conditions, many engineers have had to revise their work schedules to a 6-day basis. To help other engineers who may have this problem, stated in Question No. 231, a number of readers have made their 6-day schedules available. Perhaps one of them will fit your conditions or can be easily adapted to them. This is one of those details of plant management that may seem unimportant but have an important effect in organizing a power plant force into a smooth-running team, working toward a common purpose

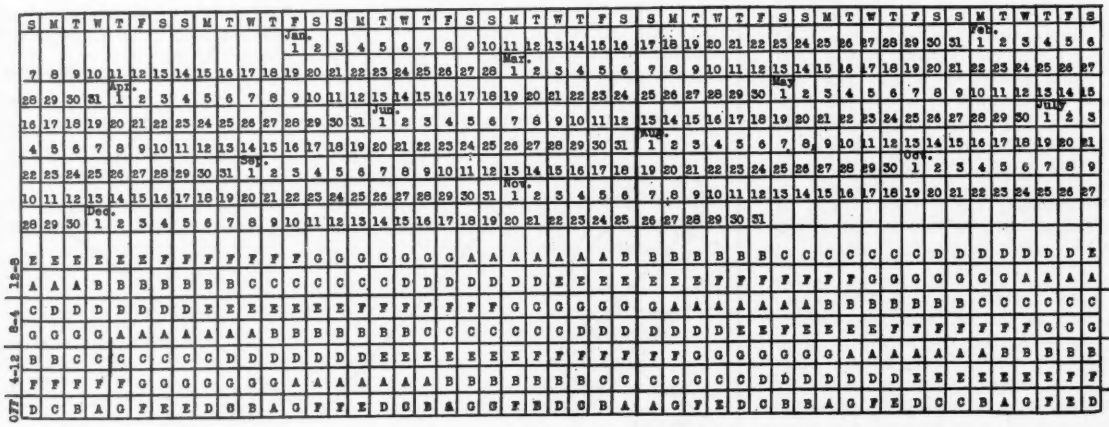


Fig. 1. Schedule supplied by C. A. S. Hickman for 6-day week. Schedule changes every 7 days

48 HOUR PER WEEK SHIFT SCHEDULE YEAR -- 1943

Jan.	Sept.	Oct.	Nov.	Dec.	Day	A	B	C	D	E	F	G	
		12	30		Tue.	11-7	7-3	3-11	11-7	7-3	3-11	Off	
		13		1	Wed.	Off	7-3	3-11	11-7	7-3	3-11	11-7	
		14		2	Thur.	7-3	Off	3-11	11-7	7-3	3-11	11-7	1st Week
1		15		3	Fri.	7-3	3-11	Off	11-7	7-3	3-11	11-7	
2		16		4	Sat.	7-3	3-11	11-7	Off	7-3	3-11	11-7	
3		17		5	Sun.	7-3	3-11	11-7	7-3	Off	3-11	11-7	
4		18		6	Mon.	7-3	3-11	11-7	7-3	3-11	Off	11-7	
5		19		7	Tue.	7-3	3-11	11-7	7-3	3-11	Off	11-7	
6	1	20		8	Wed.	7-3	3-11	11-7	7-3	3-11	11-7	Off	
7	2	21		9	Thur.	Off	3-11	11-7	7-3	3-11	11-7	7-3	2nd Week
8	3	22		10	Fri.	3-11	Off	11-7	7-3	3-11	11-7	7-3	
9	4	23		11	Sat.	3-11	11-7	Off	7-3	3-11	11-7	7-3	
10	5	24		12	Sun.	3-11	11-7	7-3	Off	3-11	11-7	7-3	
11	6	25		13	Mon.	3-11	11-7	7-3	3-11	Off	11-7	7-3	
12	7	26		14	Tue.	3-11	11-7	7-3	3-11	Off	11-7	7-3	
13	8	27		15	Wed.	3-11	11-7	7-3	3-11	11-7	Off	7-3	
14	9	28		16	Thur.	3-11	11-7	7-3	3-11	11-7	7-3	Off	
15	10	29		17	Fri.	Off	11-7	7-3	3-11	11-7	7-3	3-11	3rd Week
16	11	30		18	Sat.	11-7	Off	7-3	3-11	11-7	7-3	3-11	
17	12	31		19	Sun.	11-7	7-3	Off	3-11	11-7	7-3	3-11	
18	13		1	20	Mon.	11-7	7-3	3-11	Off	11-7	7-3	3-11	
19	14		2	21	Tue.	11-7	7-3	3-11	Off	11-7	7-3	3-11	
20	15		3	22	Wed.	11-7	7-3	3-11	11-7	Off	7-3	3-11	
21	16		4	23	Thur.	11-7	7-3	3-11	11-7	7-3	Off	3-11	
22	17		5	24	Fri.	11-7	7-3	3-11	11-7	7-3	3-11	Off	4th Week
23	18		6	25	Sat.	Off	7-3	3-11	11-7	7-3	3-11	11-7	
24	19		7	26	Sun.	7-3	Off	3-11	11-7	7-3	3-11	11-7	
25	20		8	27	Mon.	7-3	3-11	Off	11-7	7-3	3-11	11-7	
26	21		9	28	Tue.	7-3	3-11	Off	11-7	7-3	3-11	11-7	
27	22		10	29	Wed.	7-3	3-11	11-7	Off	7-3	3-11	11-7	
28	23		11	30	Thur.	7-3	3-11	11-7	7-3	Off	3-11	11-7	
29	24		12	31	Fri.	7-3	3-11	11-7	7-3	3-11	Off	11-7	5th Week
30	25		13		Sat.	7-3	3-11	11-7	7-3	3-11	11-7	Off	
31	26		14		Sun.	Off	3-11	11-7	7-3	3-11	11-7	7-3	
	27		15		Mon.	3-11	Off	11-7	7-3	3-11	11-7	7-3	
	28		16		Tue.	3-11	Off	11-7	7-3	3-11	11-7	7-3	
	29		17		Wed.	3-11	11-7	Off	7-3	3-11	11-7	7-3	
	30		18		Thur.	3-11	11-7	7-3	Off	3-11	11-7	7-3	
		1	19		Fri.	3-11	11-7	7-3	3-11	Off	11-7	7-3	6th Week
		2	20		Sat.	3-11	11-7	7-3	3-11	11-7	Off	7-3	
		3	21		Sun.	3-11	11-7	7-3	3-11	11-7	7-3	Off	
		4	22		Mon.	Off	11-7	7-3	3-11	11-7	7-3	3-11	
		5	23		Tue.	Off	11-7	7-3	3-11	11-7	7-3	3-11	
		6	24		Wed.	11-7	Off	7-3	3-11	11-7	7-3	3-11	
		7	25		Thur.	11-7	7-3	Off	3-11	11-7	7-3	3-11	
		8	26		Fri.	11-7	7-3	3-11	Off	11-7	7-3	3-11	7th Week
		9	27		Sat.	11-7	7-3	3-11	11-7	Off	7-3	3-11	
		10	28		Sun.	11-7	7-3	3-11	11-7	7-3	Off	3-11	
		11	29		Mon.	11-7	7-3	3-11	11-7	7-3	3-11	Off	

Fig. 1A. Tabulation of men to list on Fig. 1

	1	2	3	Relief
SUPERVISOR	A	B	C	D
FOREMAN	E	F	G	D
WATER TENDER	E	F	G	D
FIREMAN	A	F	G	D
FIREMAN	E	B	C	
SWITCHBOARD	A	B	C	D
TURBINE OPR.	A	B	C	
HOUSE TURBINE OPR.	E	F	G	D
BOILER OILER	A	B	G	
CONDENSER OILER	A	B	C	D
BOILER OILER HELPER	E	F	G	

THE SCHEDULE shown in Fig. 1 is used by Champ A. S. Hickman, Morgantown, W. Va. To work out a schedule like this, says Mr. Hickman, "divide each shift up, starting with the supervisors and going down through the operators. Give each man a shift letter. For example, on the 12-8 shift, E works with the A shift for part of the week, say three days, then the B shift comes on and works with E the remainder of the week and continues until it has worked seven consecutive days, then it has a day off. The schedule changes every seven days." It will be seen that a man on any given shift, although he works seven days consecutively, gets one day off each week—but not the same day.

The schedule from Charles W. Parks, Baltimore, Md., shown in Fig. 2, is made up for an entire year and posted under glass in each department, so that each man in a few seconds can find what day or what shift he is working on for any week of the year. The schedule is arranged for the payroll week to start on Tuesday but can be

Fig. 2. Schedule for 6-day week for an entire year supplied by C. W. Parks. Note that it starts on Tuesday, beginning of pay period; other periods just change the dates and days

JULY 1943

Day & Date	Day 1 Shift A	PM 2 Shift B	AM 3 Shift C	4 Relief D
Mon. 12	AM-8:00-4.00	PM-4:00-12:00	Off	AM-12:00-8:00
Tue. 13	8:00-4:00	4:00-12:00	AM-12:00-8:00	Off
Wed. 14	8:00-4:00	4:00-12:00	12:00-8:00	AM-8:00 4:00
Thu. 15				
Fri. 16				
Sat. 17	Off			
Sun. 18		Off	12:00-8:00	PM-4:00-12 00
Mon. 19			Off	AM-12:00-8:00
Tue. 20				Off
Wed. 21	8:00-4:00	4:00-12:00	12:00-8:00	AM-8:00-4:00
Thu. 22				
Fri. 23				
Sat. 24	Off			
Sun. 25	8:00-4:00	Off	12:00-8:00	PM-4:00 12:00
Mon. 26	8:00-4:00	Off	12:00-8:00	PM-4:00-12:00
Tue. 27	8:00-4:00	4:00-12:00	Off	AM-12:00-8 00
Wed. 28	PM-4:00-12:00	AM-12:00-8:00	AM-8:00-4:00	Off
Thu. 29				AM-8:00-4:00
Fri. 30				
Sat. 31				
Sun. 1	Off	12:00-8:00	PM-4:00-12:00	AM-8:00-4.00
Mon. 2	4:00-12:00	Off	AM-12:00-8:00	AM-8:00 4 00
Tue. 3	4:00-12:00	12:00-8:00	Off	8:00-4:00
Wed. 4	4:00-12:00	12:00-8:00	AM-8:00-4:00	8:00-4:00
Thu. 5				
Fri. 6				
Sat. 7				Off
Sun. 8	Off	12:00-8:00	PM-4:00-12 00	8:00-4:00
	2	3	4 Relief	1

Fig. 3. Schedule for 6-day week for month of July, supplied by Ben H. Whitehouse

1st Week	12 M-8 a.m.	8 a.m.-4 p.m.		4 p.m.-12 M	Rest Period
Sun.	1	2		3	4
Mon.	4	2		3	1
Tues.	1	4		3	2
Wed.	1	2	4 maintenance	3	
Thurs.	1	2	4 "	3	
Fri.	1	2	4 "	3	
Sat.	1	2		4	3
2nd Week					
Sun.	3	1		4	2
Mon.	2	1		4	3
Tues.	3	2		4	1
Wed.	3	1	2 maintenance	4	
Thurs.	3	1	2 "	4	
Fri.	3	1	2 "	4	
Sat.	3	1		2	4
3rd Week					
Sun.	4	3		2	1
Mon.	1	3		2	4
Tues.	4	1		2	3
Wed.	4	3	1 maintenance	2	
Thurs.	4	3	1 "	2	
Fri.	4	3	1 "	2	
Sat.	4	3		1	2
4th Week					
Sun.	2	4		1	3
Mon.	3	4		1	2
Tues.	2	3		1	4
Wed.	2	4	3 maintenance	1	
Thurs.	2	4	3 "	1	
Fri.	2	4	3 "	1	
Sat.	2	4		3	1

Fig. 4. Schedule supplied by Thad L. Taylor, a rotating schedule using four men per occupation

changed to fit any conditions by rearranging the days of the week.

Figure 3 is the schedule used by Ben H. Whitehouse, Plant Engineer, A. O. Smith Corp., Milwaukee. He says: "While there are times when men work more than six days in succession, if you consider a weekly work period beginning on the same day each week, each man works six days and has one off day. The pay periods are all for six days. No man is required to leave work and return in less than 16 hr. No man is required to work more than 8 hr without relief. One crew has two days off in succession once in each period of four weeks.

"In the schedule, Fig. 3, A is the group of men on the first or day shift, B is the group of men on the second or P. M. shift, C is the group of men on the A. M. or third shift. It is made out for a 48-hr week and the time of each shift is inserted to avoid confusion. However, by letting the shifts overlap, the schedule adapts itself to any number of hours from forty-eight up."

Mr. Whitehouse says the employees under him, for whom he worked out

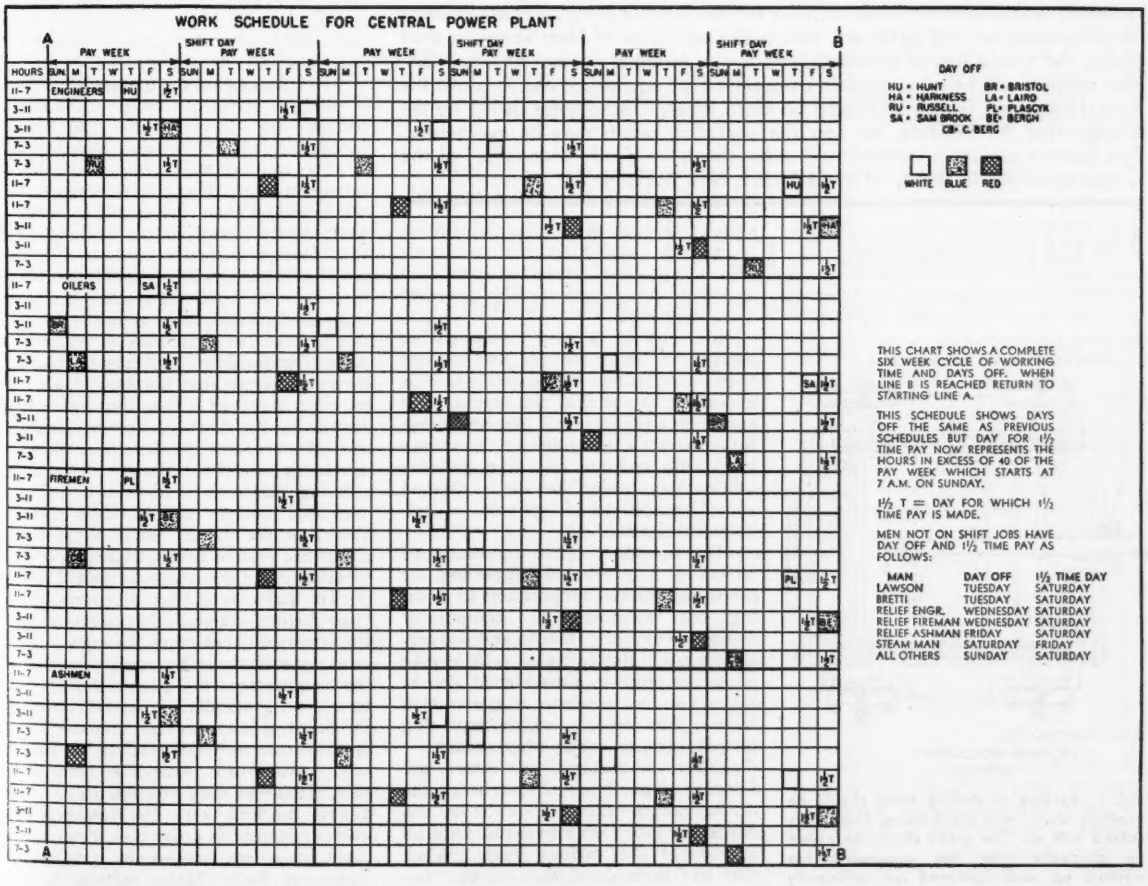

WORK SCHEDULE FOR CENTRAL POWER PLANT
PAY WEEK
SHIFT DAY PAY WEEK
HOURS
SUN M T W T F S
ENGINEERS
OILERS
FIREMEN
ASHMEN
DAY OFF
HU = HUNT
HA = HARKNESS
RU = RUSSELL
SA = SAM BROOK
CB = C. BERG
BR = BRISTOL
LA = LAIRD
PL = PLASCYK
BE = BERGH
WHITE
BLUE
RED
THIS CHART SHOWS A COMPLETE SIX WEEK CYCLE OF WORKING TIME AND DAYS OFF. WHEN LINE B IS REACHED RETURN TO STARTING LINE A.
THIS SCHEDULE SHOWS DAYS OFF THE SAME AS PREVIOUS SCHEDULES BUT DAY FOR 1½ TIME PAY NOW REPRESENTS THE HOURS IN EXCESS OF 40 OF THE PAY WEEK WHICH STARTS AT 7 A.M. ON SUNDAY.
1½ T = DAY FOR WHICH 1½ TIME PAY IS MADE.
MEN NOT ON SHIFT JOBS HAVE DAY OFF AND 1½ TIME PAY AS FOLLOWS:
MAN — DAY OFF — 1½ TIME DAY
LAWSON — TUESDAY — SATURDAY
BRETTI — TUESDAY — SATURDAY
RELIEF ENGR. — WEDNESDAY — SATURDAY
RELIEF FIREMAN — WEDNESDAY — SATURDAY
RELIEF ASHMAN — FRIDAY — SATURDAY
STEAM MAN — SATURDAY — FRIDAY
ALL OTHERS — SUNDAY — SATURDAY

Fig. 5. Schedule supplied by L. A. Teasdale. Day off goes with shift, and shifts in hours are made every two weeks at beginning of pay week

the schedule, seem really enthusiastic about it. They all work a 56-hr week, as they requested. The shifts overlap each other at beginning and end. The men work two 10-hr days, four 9-hr days. This gives them 56 hr a week and they are paid for 64 hr.

In Fig. 4 is shown the schedule made up by Thad L. Taylor, Chief Engineer, The Union Malleable Iron Co., East Moline, Ill. He says he and his men have found it quite satisfactory. It is a rotating, three-shift schedule, using four men per occupation.

Figure 5 is the work schedule of Lawrence A. Teasdale, Manager, Division of Heating & Lighting, Yale University, New Haven, Conn.

"This schedule," says Mr. Teasdale, "is based on six working days of 8 hr each per day, or 48 hr per week total. Due to an agreement with our men, time-and-one-half is paid for all working time over 40 hr per week, therefore the last working day of each pay week is shown in the schedule at 1½ time pay.

"Shifts in hours are made every two weeks and the shift is made at the beginning of the pay week. In all cases, the day off goes with the shift and not with the man. In the schedule, the square shown for one day each week represents the day off. For example, the engineer on the 11 p. m. to 7 a. m. shift the first week, starting from A, works Sunday, Monday, Tuesday, Wednesday, Friday and Saturday, and has Thursday off. The next week he goes back to the 3 p. m. to 11 p. m. shift, works Sunday to Friday, inclusive, and has Saturday for his day off. After two weeks he goes back to the 7 a. m. to 3 p. m. shift and has Tuesday off."

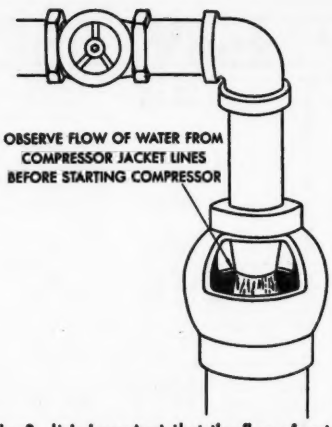


Fig. 2. It is important that the flow of water through jacket lines be observed. An open funnel as shown here or sight pressure glasses are recommended

Keeping Compressed Air Plants In Shape

Compressors of all types have such an important part in practically every one of the major war programs, and their supply is so critical, that the War Production Board is allocating their purchase and production. They are an essential part of the equipment used in shipbuilding, ammunition and explosives in all stages of manufacture, in the production of airplanes, tanks, guns, aviation gasoline, rubber and all similar supplies for the fighting forces. Huge volumes of compressed air and gases are used in the operation of blast furnaces, steel plants, the production of aluminum, and similar essential needs. Any contribution which would help to maintain compressed air equipment and improve the operating results therefrom should be quite timely. These notes issued by the Compressed Air Institute, tell how the operating results may be maintained. This general subject is treated more exhaustively in "Trade Standards" of the Compressed Air Institute, 90 West Street, New York, N. Y.

IN THE OPERATION of compressed air equipment, it is important that the original installation is correctly made, that the compressors and pipe lines are properly placed with respect to each other, that lubrication is carefully carried out, that the whole unit is kept clean, protected from dust and dirt, and systematically inspected and maintained.

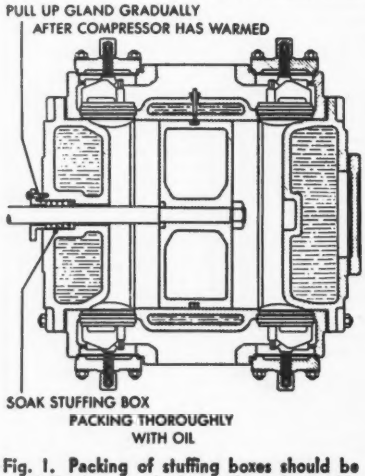


Fig. 1. Packing of stuffing boxes should be carefully done, with the packing thoroughly soaked with oil. The gland should be pulled up gradually after the compressor has warmed up, and tightened just sufficiently to prevent blowby along the rod

In starting a new reciprocating compressor or an old one that has not been in operation for sometime, it is necessary to see that the crankcase is carefully cleaned of all grit and other foreign matter and filled to the proper level with suitable oil. The cylinder lubricators should likewise be flushed and filled with an oil suitable for cylinder lubrication.

The operator should be cautioned never to use kerosene, gasoline, or other light petroleum products in flushing out cylinders or compressor frames. They are volatile and dangerous to use! Better waste a little lube oil in the process. Care should also be taken not to use waste or rags which leave a lint deposit, which may clog oil passages, or cause other damage.

When mechanical lubricators are filled, it is good practice to break the oil line joints nearest the cylinder and crank the lubricators by hand until oil appears at the various joints. When this has been done, the operator can reconnect the piping with assurance that the cylinders will be provided with oil immediately upon starting.

Packing of the stuffing boxes should be carefully done. Any packing used should be thoroughly coated with oil. If soft packing is to be employed, it should be soaked in oil over night so as to impregnate it as thoroughly as possible. The packing should not be pulled too tightly at the start, for this is liable to score the piston rods; rather the gland may be pulled up gradually after the compressor has warmed up and tightened just sufficiently to prevent blowby along the rod. (See Fig. 1.)

Starting the Compressor

Before starting, make absolutely certain that the intake line has been thoroughly blown out and cleaned of all dirt, welding shot, scale, and other foreign matter. Many new compressors have had their valves and cylinder walls badly damaged by sucking in such foreign matter.

The cooling water should then be turned on to make sure there are no leaks in the water lines or in the cylinder jackets and that there is no stoppage of water flow. Jacket lines should be so connected that the flow of water may be observed either into an open funnel on the discharge or by means of sight pressure glasses, if a closed system is used (See Fig. 2). The circulating water lines from both cylinders and coolers should have drain valves at the lowest point to permit the entire system being drained in cold weather if the equipment is shut down.

To make sure that all parts are clear before starting the compressor, the operator should turn the equipment over several times by hand. To start the compressor, the power should be turned on gradually. It is well during the first few hours to start and stop the machine intermittently, feeling the various bearings for excessive temperature. It is common practice to run in a new machine with the compressor valves removed in order that the equipment may be broken in gradually under no load. Make certain when starting up that all working parts re-

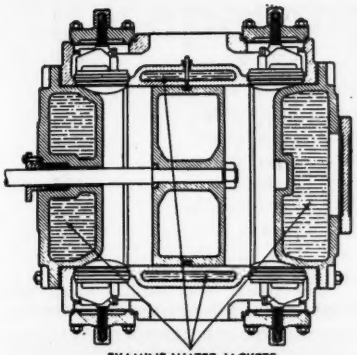


Fig. 3. Water jackets of compressors must be examined at frequent intervals and should be thoroughly cleaned regularly

quiring lubrication are getting plenty of oil and that no part is heating up. After several hours' operation in this manner, the valves may be replaced, making certain that the jam screws which hold the valves on their seats are screwed down firmly. The machine may then be started with all the valves installed, being careful to build up the pressure slowly over a period of several hours.

If the source of power is steam, the drains on the steam cylinder and the steam pipe above the throttle must be opened before the compressor is started, to eliminate any condensation. The throttle valve should be open a very small amount before starting to permit a small amount of steam to pass into the steam cylinders to heat them gradually. After these cylinders are heated, the throttle valve may be opened sufficiently to permit the compressor to turn over slowly. If the compressor is of the single crank type, it will be necessary before starting to bar it over beyond dead center.

Maintain Log Sheet

In the operation of air compressors, it is excellent practice to establish an engine room log requiring the recording of operating data at definite periods throughout the day; also the log should record what routine daily inspections must be made, as well as what weekly and what monthly inspections should be established. As an example, instead of running the compressor without shut-down until there is evidence of a broken part, the valves should be removed and carefully examined every 6 months (every 2 months if the equipment is in 24-hr daily use). The log should also require an examination of the cylinder walls, to make certain the cylinder is properly glazed and adequate lubrication is provided. The interior of compressor cylinders may be examined by the aid of a flashlight by removing a valve.

If the equipment is operating properly, the valves should have an oily surface and be comparatively free from carbon. When reassembling, the operator should be careful to keep each valve assembly together and not interchange parts. If any head gaskets are replaced, extra care should be taken to insure water ports being cut in the gaskets, which must correspond in size and location to the parts in the cylinders and the heads. Failure to do this would cause overheating and possible serious damage.

Inspection

At pre-determined periods, the entire compressor should be carefully inspected for the presence of worn parts, new packings where needed, changing of oil in the crankcase, and inspection for complete overhaul of the equipment if it has had considerable usage. If the inspection system provides for definite routine inspection for every purpose, the equipment will be very much better maintained and cared for, with less interruption to service and lower cost of compressed air.

It is essential to examine the water jackets at frequent intervals and thoroughly clean them (See Fig. 3). Their condition is the best evidence of the suitability of the cooling water that is used. The presence of heavy, hard scale in the jackets forms an insulation which prevents the effectiveness of the water jackets. The jackets can be cleaned either by a pressure jet of water for any silt or other soft deposits, or by dilute acid if the scale is hard. The acid, 10 per cent hydrochloric (muriatic), may be forced through the jackets by a small circulating pump, or by running it from a container placed above the cylinders. It is important to neutralize the acid effect in the jackets with alkali after the acid treatment to avoid any damage being done.

In the operation of two-stage compressors, a disturbance of the normal intercooler pressure is one of the first indications of trouble. If the intercooler pressure rises, there may be something wrong in the high pressure cylinder, such as leaky or broken intake valves or a defective piston ring. If the intercooler pressure falls below normal, trouble may be looked for in the low pressure cylinder. Such a defect may also be observed by overheating of either discharge or suction valves. If the valve covers are unusually hot, there is evidence of leakage, which may be either in the valve or a blown out gasket between the valve and the cylinder. If there is a metallic knock in the compressor cylinder during each revolution, there is evidence of something being loose. The valve jam screw may not be holding the valve firmly against the cylinder, the pressure causing the valve seat to clatter against the cylinder; or the piston may be loose on the rod. These are warnings which should be promptly investigated to head off any serious damage about to occur. For instance, if the jam screw is not down tight, allowing the valve to pound up and down every revolution, the valve seat may break, causing a broken part to fall into the cylinder. The machine may be very seriously damaged by such a broken part falling into the path of the piston. Most cases of broken valve seats are caused by the valve being loose, whereas such a condition always gives ample warning.

Scale Removal By Acid At High Temperatures

By Frank Gibadlo, Salem Gas Light Co., Salem, Mass.

THE REMOVAL of scale from metallic equipment by the use of acid is generally carried out at room temperatures. High temperatures are usually avoided due to the accelerated action between the metals and acid, and on account of the additional hazard.

The feedwater heater here in the boiler room presented an exceptional case. The point was reached when the temperature pickup by this heater was too low in efficiency due to a large accumulation of hard scale on the interior of the tubes. There were ten spiral copper alloy tubes and it was impossible to clean them internally by mechanical means. The feedwater heater employed exhaust steam at 5 lb. pressure for the source of heat.

An uncontrollable leakage through the closed exhaust steam valve was sufficient to raise the temperature of water in the tubes to approximately 180 F, at which temperature the cleaning was carried out.

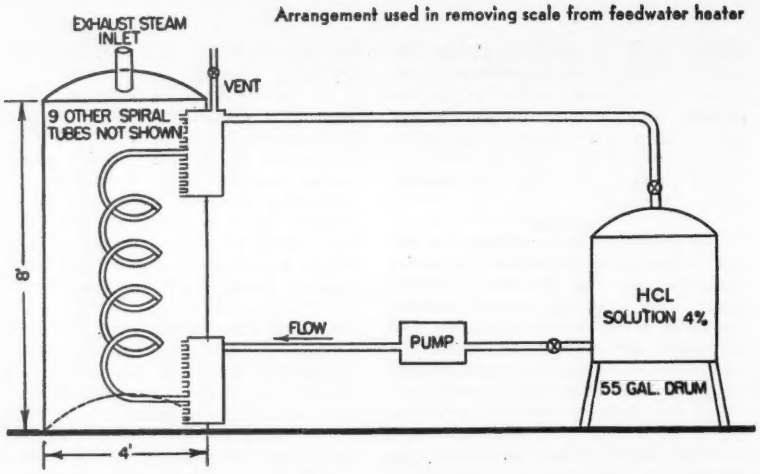
Since iron and copper alloy tubes were to be in contact with muriatic acid (HCL) preliminary experiments were conducted in the laboratory to determine the solubilities of iron and the copper alloy in muriatic acid at a temperature of 180 F. The loss of acid by evaporation from solution at a temperature of 180 F was determined. Rapid procedures for testing of acidity, iron and copper were prepared and checked for accuracy, and also checked for any interference from substances found in the scale.

Methods of Testing

ACIDITY—10 c.c. of acid solution taken and to this 10 c.c. of water is added—1 c.c. of this mixture is titrated with $\frac{N}{10}$ — Na OH using Methyl Orange indicator.

IRON—The thiocyanate colorimetric method was used: 1.0 gram of ferric ammonium sulfate made up with distilled water to 250 c.c. taken as standard solution. 1 c.c. of this solution is equivalent to 0.003 gr. iron (Fe). The color standard was made up adding in this

Arrangement used in removing scale from feedwater heater



case, 1 c.c. standard iron solution, to this 5 c.c. diluted (HNO_3) nitric acid was added and also 10 c.c. of a 5 per cent solution of potassium thiocyanate (KCNS) the whole made up to 50 c.c. with water in a Nessler tube.

From 1-10 c.c. of the sample is taken, neutralized with NH_4OH and after a few seconds redissolved in diluted nitric acid (this step will insure the oxidation of the ferrous iron to the ferric state) to this was added 10 c.c. of potassium thiocyanate and made up with distilled water to 50 c.c. in a Nessler tube and was compared with the standards above. For example if the sample solution produced a shade that was darker than the standard, and both shades of red were identical when only 25 c.c. of the sample solution was required to match 50 c.c. of the standard; therefore since 1 c.c. of standard was used (equivalent to 0.0003 gr. iron) the sample solution

$$\frac{50}{25} \times 0.0003 = 0.0006$$

therefore contains gr. iron: if 1 c.c. of the sample was initially used, per cent Fe = 0.06 per cent.

Copper — The colorimetric method was also used; copper produces a blue solution with ammonia—standard solution: 1.250 gr. of Cu SO_4 $5H_2O$ dissolved and made up to 100 c.c. with distilled water. To 10 c.c. of this solution 10 c.c. of dil. ammonia (1 part conc. NH_4OH, 9 parts water) was added and made up to 50 c.c. in the Nessler tube. 1-10 c.c. of the sample was taken and neutralized with the dil. ammonia and then 10 c.c. added in excess. The sample was then ready for the color comparison with the standard.

These tests for iron and copper were not interfered with by the soluble substances that were contained in the scale.

Solubilities of the Metals

A section of copper alloy tubing, a strip of copper and an iron rod were subjected to a 4 per cent hydrochloric acid solution. Since the areas of the metals, and the amount dissolved in the acid was known, the equivalent layer or thickness dissolved was calculated. It was assumed that the metals dissolved uniformly.

Acid Loss

The loss of acid from a 4 per cent solution at a temperature of 180 deg. F. for 5 hr. was found to be 5 per cent.

An old reciprocating steam pump was used, connected as in the sketch.

Procedure

The acid was mixed in the 55 gal. drum. A solution of muriatic acid was made up, the strength of which was to be 4 per cent as HCL made up by mixing 1 gal. of 22 deg. Be muriatic acid with 9 gal. of water. It was estimated that 40 gal. of solution was required; so 4 gal. of acid and 36 gal. of water were mixed up in the drum.

The cleaning was run off in batches of 40 gal. until there was no appreciable decrease in the acid strength. The acid solution was circulated at the rate of 30-50 g.p.m. and tested whenever possible and convenient for acidity, iron and copper.

1st day	C.C. N NaOH — 10	Per cent HCL	(1st batch) (a) Per cent Fe	Per cent Cu
9:30 A.M.	4.2	4.5		
10:00 A.M.	2.5	3.7		
10:15 A.M.	0.5	.5	(b) .3	No trace

(a) Previous analyses of scale showed 6.8 per cent Fe_2O_3.

(b) Next morning same solution gave .006 per cent Fe. Muriatic Acid as received contained .017 per cent Fe.

		(2nd batch)		
10:45 A.M.	3.2	3.9		
11:45 A.M.	.6	.7		
12 Noon	.4	.4		
1:30 P.M.	.1	.1	.02	Trace
2nd day		(3rd batch)		
1:45 P.M.	2.0	2.2		
2:30 P.M.	1.5	1.6		No Trace
3:00 P.M.	1.0	1.2		
3:30 P.M.	.8	.9		
4:00 P.M.	.5	.6	.02	Trace

It was felt that at this point the major portion of the scale had been removed.

A composite sample was made up from all the test solutions and the quantity of residue determined and subsequently analyzed for its main constituents: from the amount of residue left and from the amount of solution used in the cleaning, the quantity of scale removed was calculated—this was found to be approximately 50 lb.

	Temp.	Time	Thickness dissolved	Temp.	Time	Thickness dissolved
Copper alloy tube	80°F.	18 hr.	.00018 in.	180°F.	2 hr.	.00004 in.
Copper strip	80°F.	18 hr.	.0004 in.	180°F.	2 hr.	.00004 in.
Iron rod	80°F.	18 hr.	.0005 in.	180°F.	2 hr.	.003 in.

Analysis of Residue (Scale)

	Per cent
Al_2O_3	36.0
Fe_2O_3	8.0
$CaCO_3$	20.0
PO_4	3.0
Mg	2.0
SiO_2	12.0
Organic & other occluded	
Salts	19.0
Cu	Trace
	100.0

Effect of Cleaning

The heater was flushed clean with fresh water, and the tubes were then inspected. The major portion of the scale was removed with but small patches remaining. The increase in the temperature of the feedwater after the cleaning was found to be approximately 20 F. Previous to the cleaning the feedwater temperature with a normal load varied from 160-180 F, with a similar load the temperature after the cleaning varied from 180-210 F. Approximately 11,475 lb water are pumped per hour: at 20 F increase in temperature this effects a saving of:
11,475 × 20 = 229,500 Btu per hr.

Summary

The procedures for the quantitative determination of acidity, iron and copper were found to be rapid and accurate for control work of this nature.

There are, however, several precautions to be taken; samples should be tested as soon as possible, and if they are to be tested a few hours later there is a tendency for silicic acid, which possesses colloidal properties, to adsorb other ions, and to coagulate out of solution. As shown in the table the quantity of iron in solution is greatly reduced by standing overnight. So in order to determine the total iron and copper in old samples the sludge must also be taken. The periodic test for iron to determine the extent the iron equipment is being attacked by the acid would only be used when the scale contained a negligible amount of iron oxide. In the case of copper, a condition that is generally apt to be overlooked and should be emphasized where a close check is desired on the amount of copper that is being dissolved: laboratory experiments have shown that dissolved copper in neutral or HCL solutions will plate out on a clean iron surface in a few minutes. Small amounts of plated-out copper were found on the smooth surfaces of the pipe couplings and a thin film was found on the sides of the 55 gal. drum. It is evident that the initial amount of copper in solution is higher than the actual amount found by test; the difference being plated-out on clean iron. To eliminate some of this plating-out of the copper, shorter iron pipes, or pipes coated with an unreactive substance, is suggested. A rapid circulation of the solution will also minimize the loss of copper temporarily.

The loss of iron and copper by action of a 4 per cent solution at the temperature of 180 F was found to be negligible. The cleaning also proceeded at a faster rate and attacked the tougher layers of scale with greater ease.

Repairing A Worn Rubber Belt

Here is a picture story of a repair made on a 48-in. conveyor belt which in a period of two years and nine months hauled 7 million tons and then failed. Who wouldn't? At first it was decided to discard the belt as scrap, but an alert belt maintenance man decided to make vulcanized repairs. Repaired, the belt gave an additional 18 months service before it was finally replaced, and hauled an extra 4 million tons. When new, this belt contained 7900 lb of rubber. It is estimated that over 2000 lb of rubber was saved by the repair. The photographs show, step by step how the worn portions were repaired. This method is applicable to any large rubber belt. The photos were supplied by the B. F. Goodrich Co.

Fig. 1. Close-up of a typical conveyor belt injury showing the first step in making a repair—stripping off the rubber cover

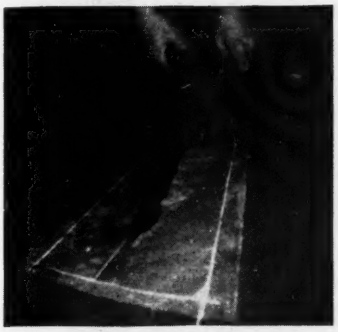


Fig. 2. The first ply is pulled off. Notice the size of the step marked off by white chalk marks

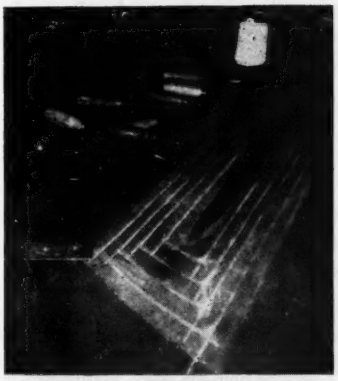


Fig. 3. All plies removed; ready to be trimmed and buffed

Fig. 4. Applying the first coat of rubber cement after buffing

Fig. 5. The first step is filled in with a strip of fabric. Note that the first step is the narrowest one

Fig. 6. The third ply is filled in. In this manner, each ply laid in place

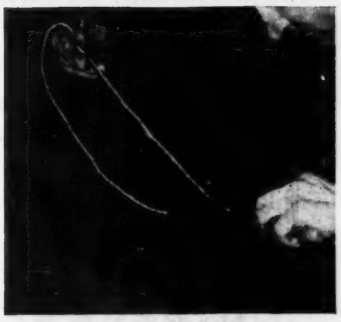
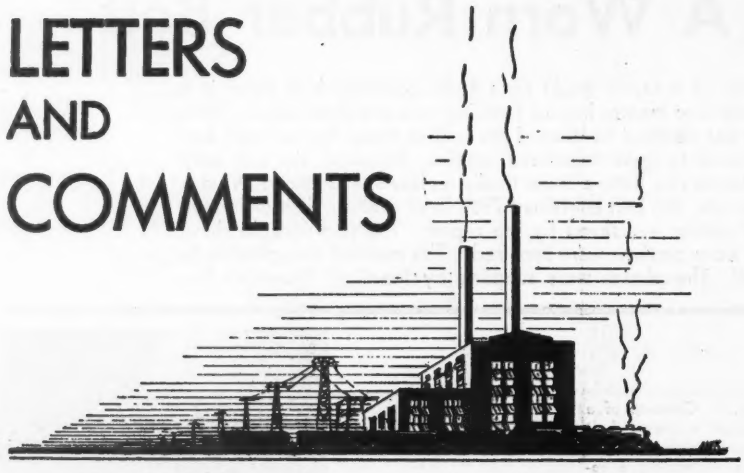


Fig. 7. The top ply is trimmed after all the steps are in place

Fig. 8. Portable electric vulcanizer gives proper cure to make repair as strong as new belting

LETTERS AND COMMENTS



More Hair-Raising Experiences

ROBERT BAKER'S "Hair-Raising Refrigeration Experiences," in the May issue, recall vividly to my mind two incidents that occurred a few years ago while I was assistant electrician and mechanic for a small furniture manufacturing concern. These incidents were unusual because they were the type usually written up in insurance reports and obituaries with no survivors to tell the tale.

We had three very old Hrt boilers supplying steam to an equally old Corliss engine that drove our generator. The boilers were wood burning, hand-fired and heavily loaded. The makeup water came directly from the river with no filtration of any kind.

One particular Saturday afternoon, I had just finished some repair work and was passing through an alley in back of the boilers on my way out of the factory, when I heard water dripping. The sound seemed to come from back of the middle or No. 2 boiler so I opened the ash pit cleanout door and crawled into the ash pit. (The boilers were shut down at night and on week ends.)

I flashed my light over the boiler shell but could find no leak. I started around the firebrick column that protected our blowdown line and right there I nearly jumped out of my skin! Not only had I found the elusive dripping water, but also a big blister whose every contour seemed to shriek explosion.

I nearly jumped out of my skin

He stood directly in front of the switch

The blister was about a foot in length and about 3 inches deep. It was in the bottom of the boiler shell about 1½ ft in front of the blowdown take off. The boiler metal was stretched so thin at the base of the blister that an opening had appeared through which water was leaking.

I reported the situation to the chief mechanic who called in an experienced boiler repair crew. When the blister was cut out we found it packed with mud, making it very evident that we had not been blowing down sufficiently.

By Monday morning we had riveted and caulked in a nice patch. The boiler was hydrostatically tested and went back in service on schedule. We increased our blowdown considerably and assumed that everything would be O.K.

On the following Saturday we inspected the boiler again, and lo and behold! there was another blister larger and more dangerous looking than the first one. All the rivet holes were stretched so badly water was leaking out in half a dozen different places.

The boiler repair crew was again called in and another much larger patch installed. This time we doubled our blowdown when the boiler went back in service.

The Negro fireman was so scared he used to come back in the boiler house every night and as soon as the boiler had cooled down sufficiently he would crawl into the No. 2 ash pit to inspect that last patch. However, it held satisfactorily and subsequent inspection found it in good shape.

On another occasion the chief electrician and I were replacing a starting coil on a 550-v auto starting compensator. Between the compensator and the feeder tie-in was a disconnect switch which was of course open while we were working.

We finished the installation, checked the starting linkage in neutral and the chief electrician quickly stepped over to reclose the disconnect.

The switch exploded with a blinding flash

He had always carefully instructed me, when closing a switch of this type, to stand off to the right, use my left hand on the switch handle and wear gloves.

At this time the chief, presumably because we were in a hurry, violated completely his own safety rules. He stood directly in front of the switch, braced himself with his left hand and operated the switch handle with his right hand, with no gloves on and the switch box door slightly open.

When he closed the circuit the switch exploded with a blinding flash that seemed to fill the entire room with flame. The chief was terribly burned, especially his eyes. My eyebrows were singed and face scorched although I was about four feet away.

The switch was tied into our main plant feeder on the secondary side of our

the Shell Game

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main transformer bank, the primary side being 440 v. The reaction from the explosion was so severe that our 4400 v purchased power breaker, tie breaker, and generator breaker in the engine room were knocked out, resulting in a plant shutdown.

The chief and I both fell to the floor supposedly from nerve shock. I managed to get the chief out to a doctor, had my own burns treated and put the mentioned breakers back in service.

This accident was a terrible lesson that forcibly bears out the fact that a departure from even the simplest safety rule will often result in disaster. Subsequent examination never revealed why the switch failed. All of the copper of the moving and stationary blades was gone, not even molten metal remained, but the fuses, fuse block and switch block were in good condition except for being seared by heat. I took the fuse links out and used them later in another switch.

Morgantown, W. Va. DENARD L. GUSLER

A Letter to Service Sam

THE LETTER from Service Sam, whoever he is, that you printed on the first page of the Practical Engineer Section in the August issue, is absolutely right. We certainly should get down to brass tacks in the power plant field and give out with some practical plans of what each one of us could do in his own individual plant. As Service Sam indicates, this would do us and the country a whole lot more good than sitting around beefing about the international situation and the political situation and rationing and all the rest of it, although I will say that it sure does help to be able to get some coffee once more.

But while I agree 100 per cent with Service Sam, it's not quite so easy to make these post-war plans as he would have us think. We read all these swell ads in the magazines and my wife talks about how after the war she'll have a glass stove that she can roll around to any room in the house and do the cooking where she feels like it and watch what's going on—maybe by this new radiant heat business. Then she says we can have doors open with the electric eye and all that sort of thing.

Well, I hate to disillusion her so I don't tell her that "Sure, an electric eye only costs maybe $8 or $10—the electric eye itself is only a control device—you've got to have about $150 worth of motors and gearing and linkage to open the door and all the electric eye does is control the operation of the motor—it's the motor that does the work."

Now, it's perfectly true in the power plant field the advertising of the various manufacturers has not gone off the deep end with a lot of hooey about the wonderful products we are going to be able to get after the war. They're too busy right now helping us to keep our plants going with what they've got and what they can spare for us after Uncle Sam's nephews are taken care of—which is, of course, the way it should be.

But there's an awful lot of talk going around, especially among people in industry who are not familiar with the power business. For example, the executives of one industry I know are all het up about the gas turbine and are asking their engineer about it, but he can't find out much more than what has been published in POWER PLANT ENGINEERING and other technical magazines. Sure, they'll let him see a gas turbine in operation but when he tries to find out what it would cost and whether it would be possible to generate power with it and whether he can burn coal to generate the gas or if he will have to use gas or oil fuel when everybody tells him that the latter is going to be very scarce, how can he find out whether there's any chance he'll ever be able to install a gas turbine in his plant?

Then somebody tells the vice president of the company about Velox boilers and somebody else remarks that maybe some interesting things will develop in the forced circulation type of boiler for moderate pressure and temperature, so that maybe an existing boiler can be remodeled to give more steam. But my friend has a hard time finding out about this, too. The salesmen like to tell him that "Oh, yes, after the war a lot of these things will be used very effectively"—but that isn't enough information on which to make plans. He's got to know how much it will cost and exactly how it can be done with his particular plant. For example, aren't there some pumping problems in connection with the forced circulation boiler that he will have to know about?

Then he sees references in the technical magazines to all the new metals and alloys that are now being used in various industrial processes and maybe he's got some of them in his own plant. But exactly what effect are these going to have on the design and construction of equipment after the war? Mr. Coes, in the July issue of POWER PLANT ENGINEERING, talks about alloys with very high tensile strength up to 185,000 psi and new ferro-alloys that may permit the use of temperatures up to 1100 F in power plants and chemical processes. My friend hears editors and salesmen and his fellow engineers talking a lot about these 1400-deg superheaters.

But that's all. Nobody has any real information about them. So if they are working out all right now, and if they are going to lead to changes in design and operation after the war, exactly what are those changes going to be like?

Engineers have got to know what the equipment is going to be like, what it's going to cost, whether it's going to operate on a new principle, and if so what that is, whether it can be adapted to work with their present equipment, or will have to be a completely new plant, and whether the things it will enable them to do are of interest to the men responsible for production in their industry. Just saying that these things are going to happen doesn't do the engineer a bit of good now.

For example, in my own plant I have it all figured out just how a small topping turbine would cut our power costs and at the same time give us a better source of process steam supply. But suppose, instead of the steam temperature I am now figuring on for that topping turbine, it is possible to go to 1000 or 1100 deg total steam temperature? What difference will that make in the entire cycle in my plant, both in regard to the power developed and the cost of the equipment to do it?

Those are the things I have to know in order to make any specific post-war plans.

I can't get very much specific information of this kind from the manufacturers and I am wondering if they really have it or if it is just that things are just beginning to develop now and can't be talked about for military reasons, because certainly a lot of those things would be of interest to the "Master Races" of Europe and Asia.

If that's the case, it's Okay with me and I don't want to seem too impatient about it, but certainly I can't be expected to make any definite plans until I know. On the other hand, these men who read Fortune, and Time, and Life, and are always hounding us engineers to tell them what is going to be done after the war, have got to have some patience too until we can find out more accurately just how it can be done. All we know now is that it is going to happen but when somebody comes around to close the contract, these power engineers are the boys who will have to tell them:—how big, how many pounds of steam, how many kilowatt hours, what pressure, what temperature, how it works, and above all, what it is going to cost and, as Service Sam points out, "How in heck are we going to get our money back on a deal like that?"

The few salesmen that come around to see me once in a while, so I won't forget their companies, all tell me that these wonderful things are in the offing but, as I said, I can't pin them down to much definite information. They all say that if the German section of the war folds up sooner than we expected, then our period of post-war planning will be right on top of us in a hurry regardless of how long the Japanese part of the war drags out. If that's true, all I've got to say is that their companies had better begin arming them with some engineering facts and figures so they can tell us what we'll be able to do. That's the very least we have a right to expect. I certainly want to get right down to cases as Service Sam indicates and be able to tell my management what it can expect. If we could all do that, and if the management would do only half the things that we are all dreaming of, nobody would need to worry about a post-war depression any more.

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Questions And Answers

Question No. 238

Why Electricians Chew Their Fingernails

HERE ARE two problems I have in operating the electrical equipment in a coal mine power plant:

a. What is the best way to build up the field of a generator (driven by a synchronous motor) when it has lost its residual magnetism? If I turn the field rheostat on full, would the field build up quickly? I do not want to disturb any of the generator connections.

b. Lately I have had a transformer running very hot. I am pretty certain the cold water cooling coils of copper pipe, inside the tank, are partly clogged or scaled up and that is causing the heating. How can I clean them out? Is there any liquid or solution I can run into these pipe coils to clean them out and keep them clean so they will cool the transformer properly?

Kingston, Pa. M. J. N.

Question No. 239

Where Does the Engine Get All the Btu's?

WE HAVE a good four-valve generator set, taking throttle steam at 125 psi gage, and exhausting at 5.2 psi gage, all exhaust steam being utilized. This unit consumes 40 lb of steam per kw-hr. There are approximately 1193 Btu per lb in the 125-psi steam admitted to the engine and 1156 Btu per lb in the 5.2-psi steam exhausted, the engine taking only about 37 Btu per lb out of the steam. Now 37 × 40 gives us 1480 Btu. When I look up the number of Btu in a kw-hr, 3415, I am at a loss to know how we get it. Where do the additional Btu's come from?

Los Angeles, Calif. J. D. G.

Editor's Note—This engineer is obviously thinking about some of the fundamentals involved in the operation of all steam engines and turbines. The answer lies buried under several layers of thermodynamics. These, however, are not half so muddy as they seem at first glance. Although this engineer doubtless can visualize accurately the action of steam in the engine, there is one part of this action that explains where a good share of the delivered energy comes from. He does not connect this one item, which he doubtless has observed frequently, with the thermodynamic relations involved. Let's see some of you thermo experts explain it to him as simply as possible. Doubtless many men have wondered about this same thing.

Answer No. 205

How Much Condensing Water Is Needed Here?

AND STILL the answers come! A liberal education, in the December, May and August issues, also below, not only on how to figure heat transfer but also on many practical points in condenser operation.

Condensing Water Not Far Out of Line, Says C. T. J.

THE DATA submitted by F. J. S. in Question No. 205 are not complete enough for an air-tight solution at armchair range, but by making a few assumptions it may be possible to indicate a few of the more likely sources of the trouble.

F. J. S. would like to know primarily what is causing the abnormally high water rate of his turbine and secondarily what is the reason for the low vacuum obtained. Offhand it would seem as if the low vacuum told the entire story, but to check this the internal efficiency of the turbine at present should be compared with that at the time it was operating on 150 psi saturated steam at an 18-lb. water rate.

Assuming that under the latter condition the vacuum was normal (i.e., about 28 in.) the internal efficiency was then approximately 58 per cent, as computed from water rate and adiabatic heat drop from 150 psi gage, and saturated conditions, to 28 in. Hg. vacuum. The present internal efficiency based on 28-lb. water rate and expansion to 19 in. Hg. vacuum is 49 per cent. If the internal efficiency were now 58 per cent, as before, the water rate would now be about 23 lb. per kw-hr. at the present 19-in. vacuum, or an improvement of roughly 20 per cent. At present steam conditions, with vacuum improved to 28 in., the water rate would be 17.5 lb. per kw-hr. at 58 per cent internal efficiency and 20.5 lb. per kw-hr. at 49 per cent internal efficiency, a total saving in steam over present consumption of 38 per cent and 27 per cent respectively.

From the foregoing it can be seen that F. J. S. has a large potential saving he can perhaps take advantage of, but it is not easy to improve internal efficiency, which is, so to speak, "built into" the turbine and which would probably require extensive work inside the machine for improvement. The condenser, however, is a different story for here F. J. S. should be able to effect great improvement with very little cost.

In the first place, on the basis of the figures submitted, the quantity of circulating water is not too far out of line. With a 40 F rise, 5000-kw load and 28 lb per kw-hr water rate, the quantity of circulating water works out about 320,000 lb per hr or 640 gpm, which checks roughly with the 572 gpm circulated when the machine first started operating condensing. Furthermore, the increase in temperature rise through the condenser from 30 F to 40 F should result in a falling off of only 0.3 to 0.5 in. in vacuum, not 8 to 10 in.

With the quantity of circulating water eliminated as the cause of the low vacuum there are only two things left: dirty tubes or an air leak. If it is dirty tubes, clean them. But they would have to be extremely dirty to cause the vacuum to fall from 28 to 19 in. The last and most probable cause of the trouble is air leakage. The simplest test to determine if the leakage is excessive is to shut down the air pump and observe the rate at which the vacuum decreases. It should not fall off more than 0.1 in. per min. if the system is reasonably tight. If excessive leakage is found, a few drops of oil of peppermint sprinkled on each likely place will quickly bring a telltale odor to the air pump discharge. The expansion joint between turbine and condenser and all piping and valve gaskets under vacuum are suspicious from the air leakage standpoint.

To sum up, F. J. S. should first find and remedy the cause of his low vacuum, which is probably *not* inadequate circulating water, and correct it. Then when opportunity arises, he should lift the cover and see why his turbine efficiency has dropped off.

Sterlington, La. C. T. J.

Rixman Thinks There's A Steam Leak

HERE IS my calculation of F. J. S.'s water requirements.

Lb. water required per lb. steam condensed =

$$\frac{\left(\begin{array}{c}\text{Heat of steam}\\ \text{to condenser}\\ \text{B.t.u./lb.}\end{array}\right)-\left(\begin{array}{c}\text{Heat of liquid}\\ \text{B.t.u. per lb. at}\\ \text{condenser}\\ \text{pressure}\end{array}\right)}{\begin{array}{c}\text{(Temp. outlet}\\ \text{water)}\end{array}-\begin{array}{c}\text{(Temp. inlet}\\ \text{water)}\end{array}}$$

For 170-lb. 420 deg. F. steam, total heat = 1230 B.t.u. per lb.

Expansion under constant entropy to 20 in. vac., total heat at end = 980 B.t.u. per lb.

20-in. vac., total heat liquid = 125 B.t.u. per lb.

Lb. water required per lb. steam condensed = 980 — 125 ÷ 40 = 21.5.

Lb. water required per hr. = 28 × 475 × 21.5 = 286,000.

Gal. water required per min. = g.p.m. = 286,000 ÷ (8⅓ × 60) = 572.

With clean condenser tubes, inside and out, and no air leakage into the condenser and with 28 in. vacuum, less steam and condensing water should be required for the load. Operating requirements of the condenser about as the table of guaranteed amounts. This turbine did a good job at 150 lb. and no superheat, evidently its design conditions. Wonder if some of the superheat now used is finding its way to the condenser to be lost to the condensing water? This could account for the temperature difference between

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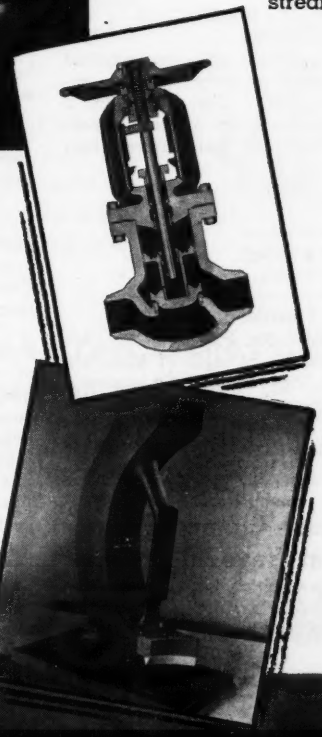

Design of the famous Edward Impactor handwheel. Lugs of wheel strike cross arm attached to stem, speeding opening or closing.

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EDWARD *Steel* **VALVES**

steam entering the condenser and the condensate.

Properly designed, this turbine, under the above conditions of 20 in. vacuum, figures to take a steam rate as follows, assuming 60 per cent turbine efficiency:

$$\frac{3415}{0.60 \times (1230 - 980)} = 22.3 \text{ lb. per kw-hr.}$$

instead of 28 lb. per kw-hr. as in the problem. This would indicate steam leakage in your turbine and reasons for high water pumpage and temperature difference of more than 30 deg.

Cincinnati, Ohio — WM. E. RIXMAN

Answer No. 218

Shrinking a Steel Cylinder Onto a C. I. Cylinder

TO SUPPLEMENT the data on calculating shrink fits given in the June issue, here is another method of calculating the diameters of the two cylinders.

Calculations by Zielinski

IN THE March issue S. S. requested information on temperatures required for shrinking a steel cylinder onto a cast iron one without passing the elastic limit of either. The radii of the cast iron cylinder were given as 2.75 (r_1), 3.00 (r_2). The radii of the steel cylinder were given as 3.00-minus (r_2), 3.25 (r_3). The difference between the outer radius of the inner cylinder and the inner radius of the outer cylinder will be indicated by d. Cast iron has an elastic limit in compression of 25,000 psi, a modulus of elasticity of 15,000,000 psi and Poisson's ratio of 0.25. Steel has an elastic limit of 40,000 psi, a modulus of elasticity of 30,000,000 psi, Poisson's ratio of 0.30 and a linear coefficient of expansion of 0.0000065 in. per inch of length per degree F.

The cast iron cylinder is analyzed first and the shrink fit pressure required to produce a stress of 25,000 psi in compression at the inner surface (r_1) is calculated. In the formulas which follow, S represents the tangential stress and P, the shrink fit pressure. A negative sign indicates compression.

$$S = \frac{-2P\,(r_2)^2}{(r_2)^2 - (r_1)^2}$$

$$-25{,}000 = \frac{-2P\,(3.00)^2}{(300)^2 - (2.75)^2}$$

$$P = 2000 \text{ psi}$$

Maximum stresses may occur either at the inner surface of the inner cylinder or the inner surface of the outer cylinder. Consequently, the stress at the inner surface of the outer cylinder has to be considered. Using the above value for shrink fit pressure, the stress in the outer cylinder at the inner surface (r_2) is calculated.

$$S = P\frac{(r_2)^2 + (r_3)^2}{(r_3)^2 - (r_2)^2}$$

$$S = 2000\frac{(3.00)^2 + (3.25)^2}{(3.25)^2 - (3.00)^2}$$

$$S = 26{,}800 \text{ psi}$$

Since this value of stress is within the allowable value, the shrink fit pressure is safe for both cylinders.

When the outer cylinder is shrunk onto the inner one, the outer surface of the inner cylinder will have a radial displacement toward the center. This radial displacement is indicated by (u_1) and is given in the equation below where E represents the modulus of elasticity of cast iron and m, Poisson's ratio for cast iron.

$$(u_1) = \frac{-(r_2)\,P}{E}\left[\frac{(r_2)^2 + (r_1)^2}{(r_2)^2 - (r_1)^2} - m\right]$$

$$= \frac{-3 \cdot 2000}{15{,}000{,}000}\left[\frac{(2.75)^2 + (3.00)^2}{(3.00)^2 - (2.75)^2} - 0.25\right]$$

$$(u_1) = -0.0045 \text{ in.}$$

The displacement of the inner surface of the outer cylinder is denoted by (u_2), where again E represents the modulus of elasticity of steel and n, Poisson's ratio for steel.

$$(u_2) = \frac{(r_2)\,P}{E}\left[\frac{(r_2)^2 + (r_3)^2}{(r_3)^2 - (r_2)^2} + n\right]$$

$$= \frac{3 \cdot 2000}{30{,}000{,}000}\left[\frac{(3.00)^2 + (3.25)^2}{(3.25)^2 - (3.00)^2} + 0.30\right]$$

$$(u_2) = 0.0027 \text{ in.}$$

The total deformation d has to account for both, the inward and outward displacements, and will be equal to the difference of the radial displacements. The signs in the above displacements indicates direction only.

$$d = (u_2) - (u_1)$$
$$d = 0.0027 + 0.0045$$
$$d = 0.0072 \text{ in.}$$

Since we are dealing with thin cylinders a linear expansion of the circumference to the required diametral elongation is assumed. The total circumferential expansion e required is given below. The initial circumference may be taken as pi times the diameter or $2 \times (r_2) \times \pi$

$$e = 2 \times 0.0072 \times 3.142$$
$$e = 0.0484$$

The temperature difference required may be obtained by using the linear expansion formula. The coefficient c represents the coefficient of linear expansion for steel, T the temperature difference:

$$e = c\,2\pi(r_2)T$$

$$T = \frac{e}{c\,2\pi(r_2)}$$

$$T = \frac{0.0484}{0.0000065 \times 2\pi \times 3.00}$$

$$T = 400 \text{ deg. F.}$$

Timoshenko's—Strength of Materials, Book 2 (D. Van Nostrand Co.), gives a complete discussion of the shrink fit problem.

Chicago, Ill. — TED ZIELINSKI

Answer No. 219

How Much Oomph Does This Float Have?

THERE WAS some disposition among the brethren to wonder if this was a bona fide question or if somebody was pulling our leg (having us on, as the English say) or trying to get somebody to stick the neck out. So far as we can determine, the question was asked in all sincerity.

Any number of men sent in the correct numerical answers, checking in the first or second decimal place depending on how far they carried out. But several of them made some illuminating comments besides.

Because it is very brief, we present first one of the straightforward numerical answers.

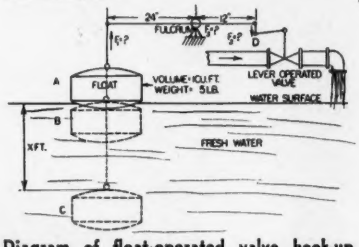

Diagram of float-operated valve hook-up. What are the forces to operate the valve?

Calculations by Kendrick

1. Force available to operate valve under the three conditions shown:

A—Floating—practically none.

B—Just submerged—62.4 lb less 5 lb (wt of float) = **57.4 lb**

C—X ft below the water surface. The same as B = 57.4 lb

2. Float just submerged—F_1 will be 62.4 lb—5 lb = 57.4 lb

3. Float in Position A—F_1 and F_2 practically nothing.

4. Float in Positions B or C—F_1 = 57.4 lb, F_2 = 114.8 lb (i.e. $1_2X = 24 \times 57.4$, X = 114.8 lb)

5. Upward Force F_3—Position A, none. Position B or C = 172.36 lb (i.e., $1_2X = 36 \times 57.4 = 2066.4$ from which X = 172.2 lb)

A submerged body is buoyed up by a force equal to the weight of the fluid displaced, irrespective of the depth of submersion. It is true that the pressure increases 0.434 psi for every foot below the surface, but since this pressure is distributed equally over the surface of the submerged body and hence balanced, this pressure cannot exert a dynamic force in any direction.

Baltimore, Md. — J. A. KENDRICK

Terry Mitchell, Waynesboro, Pa.; R. C. Baker, Clearwater, S. C.; George McNally, Kearny, N. J.; Malarkey; Fred E. Gould, Housatonic, Mass.; C. G. Clark, St. Johns, N. B.—all submitted essentially the above calculations.

"In A the balanced position is reached," says Mr. Clark, "when 5 lb of water are displaced. For control purposes, F_1 for position A depends on how much the liquid level can vary before the float moves and equals the weight of water thus displaced. Thus if the water surface rises 1 ft on the float and the float is 1 sq ft in cross-section at the point of contact, the net force F_1 is 5.2 lb, F_2 will be 10.4 lb and F_3 15.6 lb acting upward. As the float moves, the forces decrease until the new point of equilibrium is reached, when they become zero.

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"If submerged," he continues, "the float will not move due to a variation in surface level. The force tending to make a submerged float move is independent of depth since no water is displaced by any surface level variation. The force tending to collapse the float increases with depth as indicated by S.S. For float positions B and C, F_1 will be 57.4 lb unless balanced by counterweights. This is the maximum force the float described can exert but it cannot be used for control, for it is not related to surface level.

"For the largest force F_1, the float should be weighted until its greatest cross-section is at the water surface level. Valves larger than 4 in. should not be operated by direct linkage but should have a pilot valve float operated."

"If things submerged in water only sank until the pressure of the water were equal to their weight," comments Terry Mitchell, "most of the ships, as well as the trees, stones, etc. that have sunk in the ocean would be drifting around in suspension, somewhere between the surface and the bottom. Submarines would be continually crashing into these swimming bodies."

After calculating the forces as above, Mr. Mitchell goes on.

"However, the float would hardly operate in this manner, since its purpose is to shut off the water when the level rises to a point somewhere between positions A and B. If the float stayed at B or C without having enough lift to close the water valve, the tank would overflow. In actual practice, the float would become submerged only enough to exert the force required to overcome the friction in the mechanism and the valve. Otherwise a larger float will be needed."

All calculations were made with the assumption of weightless linkages.

In sending in the same calculations, Timothy E. Critz, of Cincinnati, Ohio, commented: "The F_2 of 115 (or 114.8) lb will be enough to close the valve but how will S.S. get 'oomph' enough to open it when the water level in the tank falls, the float weighing 5 lb and F_2 in that case being only 10 lb?

Mr. Hubbard and others calculate that when just floating, the float will be immersed 0.961 in.

"The depth of submergence of the float," says Malarkey, "in no way affects the force F_1 . . . although the ability of the float to do work increases as the depth below the surface. That is, the work in foot-pounds equals F_1 times X in feet. In other words, a submerged float possesses potential energy in the same manner as the raised hammer of a pile-driver."

Answer No. 220

What Makes the Marks On the Collector Rings?

Sam Says D. L.'s 300 Amp Is Too Much

ON PAGE 106 of the May issue, D. L. cites some figures in his solution of O. V. D.'s collector ring trouble. These figures are open to question if they pertain to the shutting down period of a 2000-kw alternator, correctly operated; 300 amp seems excessive for the field current of such a generator, running without load.

When an alternator is being "taken off the board", the load is gradually reduced to zero. At the same time, the field current is being reduced, so at the instant the load is zero, the field current is of such intensity as to exactly maintain bus voltage on the machine. In other words, it is the exciting current of the alternator unloaded. The main breaker is then tripped, the main field rheostat cut full in, and the field switch opened. This method provides exceedingly smooth operation, which is of especial importance in an isolated plant.

It is said that a sliding contact is the worst of all contacts. If so, the higher the velocity of the contact, the worse is the condition at the point of contact. Therefore, as the velocity of the contact decreases, so should the resistance, reaching a minimum value when the contact is stationary. If the above is true, it would seem that a ring and brush, providing contact that operates satisfactorily at 3600 rpm, carrying full field current, should operate even more satisfactorily at a speed of only a few inches per second (the last movement of the revolving field) and carrying a minimum exciting current.

D. L.'s suggestion that the rotor be allowed to spin for a period unloaded, so as to minimize cooling-off stresses, is an excellent one, and can be profitably carried out, not only with turbines, but with any heavy equipment, such as steam engines, diesels, large electric motors, etc. There is a considerable amount of heat stored up in machinery that has been operating for a long run under heavy load.

Wingdale, N. Y. SAM WILLIAMS

Answer No. 222

How Prevent Fuses from Blowing?

Main Board Fuses too Small

ALTHOUGH no single machine is overloaded, there is enough current to burn out the fuses at the main board. Assuming that the 30-amp fuses at each individual machine are low enough for proper protection, then the main fuses should be of larger capacity. The size of fuse at the board should be adequate for each individual machine to draw an overload, as in starting, but low enough so that the total main board current will not overload the main generator. Also, by putting in two 30-amp links, the rating will be 60 amp.

Erie, Pa. GERALD G. HALSTEAD

Answer No. 224

Will He Save Coal by Watching Steam Gages?

IF HE can heat his buildings with 20 tons of coal a month with 0 psi gage pressure on the heating system, asked C. C. McIlyar in the April issue, how much more coal would he burn if he kept 5 psi gage pressure on the system? Put the other way, how much does he save by keeping the pressure as low as possible?

Anything that can be done in operating heating systems to save coal during the coming winter will be a distinct contribution to the war by reducing the manpower, materials and time required to mine and transport the coal.

The two comments below both point out that he will save more than just the amount of coal involved.

Brown Thinks He'll Save More

I BELIEVE Mr. McIlyar will save much more coal than the amount that would be saved by the difference in boiler efficiency.

Many engineers are making large savings in the amount of steam consumed in heating by keeping the pressure on the heating system as low as possible and yet supplying enough heat for all of the rooms.

I believe Mr. McIlyar should install compound gages and run his pressures still lower if possible. The lower he can run his pressures, the less steam will be condensed in the radiators. If he has a vacuum return, he can run his plant at pressures below atmospheric.

A one-pipe system properly installed and kept in first-class condition will also operate on pressure below atmospheric. If C. C.'s plant is a one-pipe system he must have it in first-class shape.

If he has a two-pipe vacuum system, he should make a chart for steam pressures for different outside temperatures then he can supply whatever pressure is necessary for the outside temperature. In this way he will find he can make quite a saving in fuel.

Some allowance will have to be made for wind on windy days.

Some of the reasons why he will save steam by using lower pressures:

1. Lower temperature difference between radiator and air in room.
2. Radiator needs to be only partially filled on warmer days.
3. If rooms are not overheated, windows will not be opened to cool off room.

Orifices may have to be installed to make all radiators heat evenly on the lower pressures.

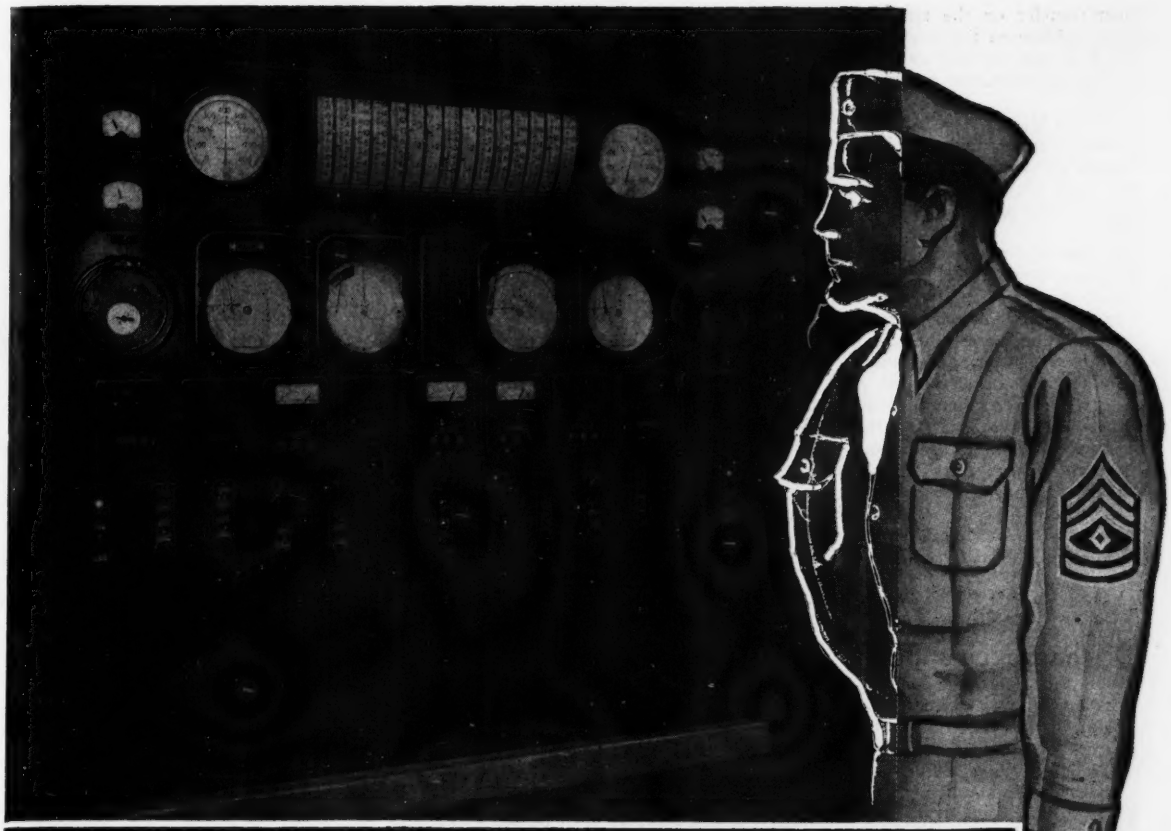
I do agree with the answer given, as far as the boiler is concerned.

Lombard, Ill. HAROLD D. BROWN

Heat Transfer Rate Governs, Says White

I THINK another interpretation may be put on this question. From my point of view, there is a decided increase in the coal consumed if the pressure of the steam is maintained at 5 psi instead of atmospheric pressure, which pressure is stated as enough to heat the building sufficiently, using 20 tons of coal per month.

Obviously the building will be overheated at the 5 psi, unless steps are taken to reduce the amount of active radiation throughout the building, which as so often happens, is not the most suitable thing to do. Then the question is governed by the rate of



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heat transfer on the temperature difference between the room temperature of 70 F and the two steam pressures, and these differences would be 142 and 158 F.

From Marks' Handbook, heat transmission section, table 8, the Btu transmitted per square foot of heating surface per hour on the respective temperature differences would be 345 and 399 for still air. The higher temperature of 5 psi steam transferring 54 Btu per hour more per square foot, which is a transfer increase of 15.7 per cent, or 15.7 per cent increase in coal consumption, over the 20 tons per month used for atmospheric steam production, an increase of 3.15 tons.

Practical experience at this place, where we have 70,000 sq ft of direct heating surface or radiation tied in with the power plant, has shown that much coal may be wasted by carrying too much pressure on the heating system.

Ponoka, Alb. (Can.) WM. S. WHITE

Answer No. 228

How Big Should Discharge Line Be?

IN THE June issue, E. G. S. asked whether he was correct in running a 1½-in. suction line to a Dean duplex 7 by 4 by 10-in. pump or whether he should have run a 2½-in. line.

G. G. Clark's calculations appeared in September and here are some more.

Calculations by Calvert

GIVEN the following data:

Dean duplex pump	7x4x10 in.
Steam pressure at pump	75 psi gage (assumed)
Water discharge pressure at drum	230 psi gage (calculated)
Size of delivery pipe	1½ in. dia
Feedwater pressure at drum	125 psi gage (assumed)
Boiler steam pressure	90 psi gage
Boiler Evaporation	3000 lb per hr
Required Pump delivery	6 gpm (calculated)

From any good handbook the following information is available: A 1½-in. pipe discharging 6 gpm has a head loss of 0.56 ft per 100 ft of pipe. And a 2½-in. pipe has a head loss of 0.07 ft per 100 ft of pipe with the same flow.

By computation the pressure drop between pump and boiler drum will require 43,300 ft or equivalent for the 1½ in. pipe, and 346,500 ft or equivalent for the 2½-in. pipe.

The head loss due to friction for the 2½-in. pipe will be 7 times less than when using 1½-in. pipe for a flow of 6 gpm.

Flushing, N. Y. JULIAN P. CALVERT

Calculations by Gusler

ASSUMING that the pump is a double-acting duplex, the basic rpm for 70-deg feedwater is about 38. To correct for 130-deg feedwater would be 73 per cent of the basic rpm or 112 power strokes a minute, which would give a piston speed of 93⅓ ft per minute. Assuming further that the water end efficiency is about 85 per cent, under the conditions outlined above the pump is capable of delivering 25,651 lb of water per hour, enough for eight 100-hp boilers. E. G. S. apparently has a lot of extra pump capacity.

At 30 lb per hp, the boiler requires 3000 lb of water per hour. Since a gallon of water weighs 8.3 lb, 3000 ÷ 8.3 = 361 gph or 6 gpm. The maximum permissible water velocity usually allowed for the suction pipe is 200 ft per min and for the discharge pipe 400 ft per min. The necessary pipe diameters can now be approximately determined from these two simple formulas.

For the suction pipe $d_1 = 0.35\sqrt{G}$
$= 0.35\ \sqrt{6} = 0.8575$ in.

For the discharge pipe $d_2 = 0.25\ \sqrt{G}$
$= 0.25\ \sqrt{6} = 0.6125$ in.

Where: d_1 = dia of pipe for 200 ft velocity of water flow
d_2 = dia of pipe for 300 ft velocity of water flow
G = amount of flow in gallons per minute

This method indicates that the 2½-in. suctions and 1½-in. discharge diameters installed by E. G. S. give a liberal allowance and should supply any demand of his 100-hp boiler.

Regarding the difference in pipe friction of 1½-in. and 2½-in. pipe, the following facts must be taken into consideration:

The friction is independent of the pressure in the pipe. It is proportional to the length of pipe and increases with roughness of the pipe. It varies nearly as the square of the velocity and inversely as the diameter of the pipe.

A formula that can be generally applied is:

$$h_f = F\frac{lV^2}{d_2g}$$

h_f = head lost by friction in feet
l = length of pipe in feet
V = velocity of water in feet per second
d = diameter of pipe in feet
g = 32.16
F = a coefficient depending on roughness of the pipe : 0.02 can be used if extreme accuracy is not necessary.

A formula for velocity in feet per minute, in the discharge pipe is:

$$V = \frac{a^8}{A}$$

a = area of water piston in square inches
S = piston speed in feet per minute
A = area of the delivery pipe in inches

The velocity in the 1½-in. delivery will probably be about 1.26 ft per sec. For purposes of comparison we can use a pipe length of 100 ft.

$$h_f = 0.02 \times \frac{100 \times 1.26^2}{0.125 \times 2 \times 32.16} = 0.37 \text{ ft}$$

for 1½-in. pipe

$$h_f = 0.02 \times \frac{100 \times 1.26^2}{0.208 \times 2 \times 32.16} = 0.236 \text{ ft}$$

for 2½-in. pipe

There is a difference of 0.134 ft which, under the circumstances, is negligible.

Morgantown, W. Va. DENARD L. GUSLER

Answer No. 229

Why Does Hot Well Level Vary With Steady Load?

THIS QUESTION was asked by W. K. in the June issue, referring to a 550-kva, 7200-v DeLaval condensing turbine generator for which he gave a table of typical condensing water temperatures and vacuum gage recordings against load.

Condensate Pump Priming Line to Condenser Will Help

YOU STATE that the water level varies from ½ in. to 8 in. in the hot well on a steady load. Does this mean it varies with 150-kw load as well as with 400-kw load?

Do you have a priming line to your condensate pump that ties in your condenser on the high-vacuum side? If you haven't, your pump, running at constant speed, discharges water faster than the load requires it to keep the pump primed. Therefore it loses its water for the time being, until the hot well is filled with enough weight of water for your pump to pick it up, to start pumping again.

With this priming line on your condensate pump, it allows the pump to be primed at all times while in operation. Also this priming line will reduce friction and prolong the life of your pump.

I suggest also that you check the sealing rings of the pump. Bad rings will cause the pumping capacity of the pump to decrease.

Vienna, Md. H. L. BROHAWN, JR.

Improper Operation of Condenser Evactor Can Cause this Trouble

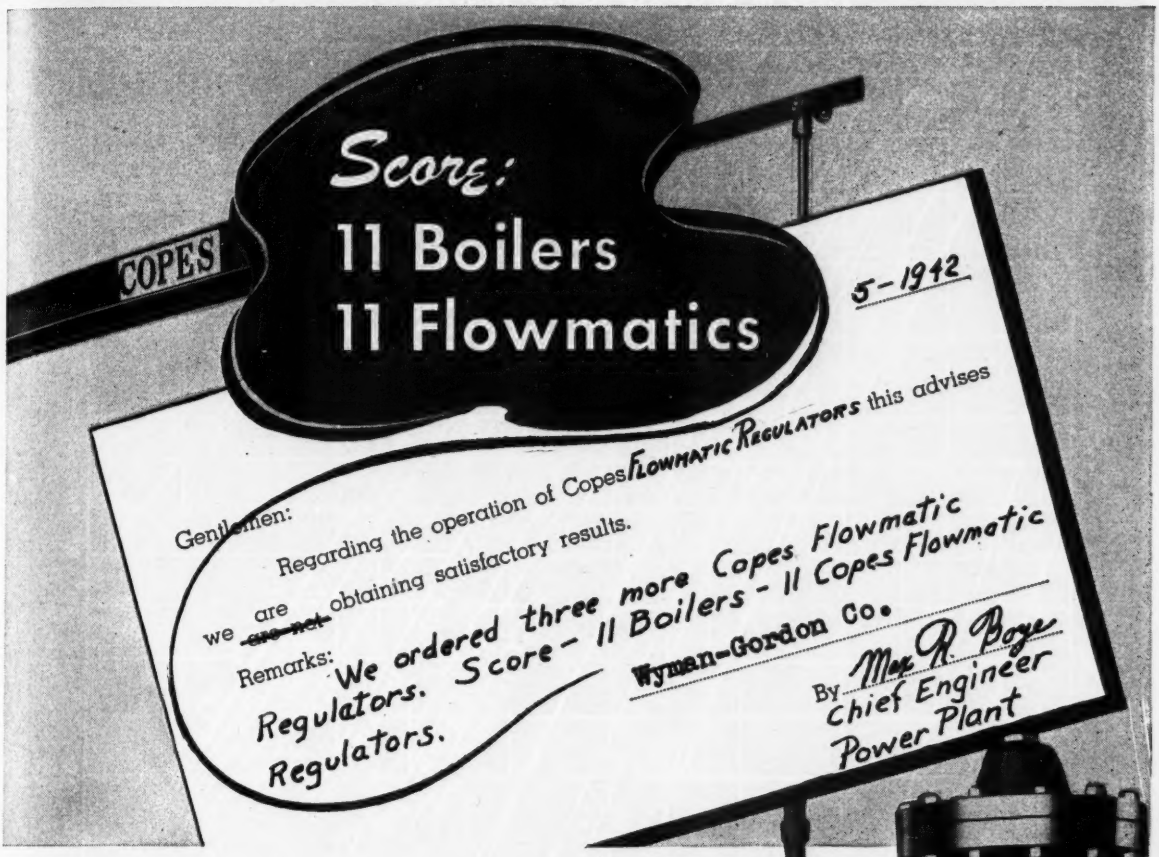
THE SUBMITTED condenser auxiliaries data shows a change in vacuum (1 to 1½ in. of mercury) with the turbine operating at constant load. We are told that the evactor jet temperature is 34 F low, which indicates that this unit is not operating properly.

If the evactor is functioning spasmodically, removing noncondensable gases at a varying rate, the back-pressure on the turbine will change accordingly. And more or less steam will be admitted by the turbine governor to enable the turbine to carry the given load. Thus the amount of condensate in the hot well will fluctuate with the steam flow if the hot well pump is handling a constant volume of water.

The hot well pump capacity will vary with the suction and discharge head pressures. However, this fluctuating hot well water level (½ to 8 in.) will not appreciably affect this pump capacity.

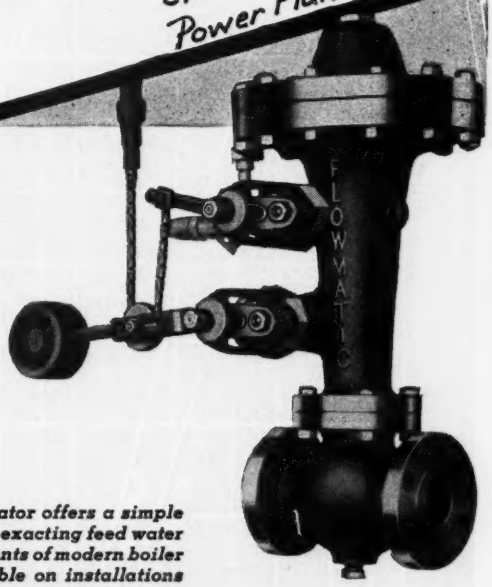
I suggest that a careful study be made of the condenser evactor.

Flushing, N. Y. JULIAN P. CALVERT



IN 1941, the Wyman-Gordon Company, Ingalls-Shepard Division, Harvey, Ill., installed their first Flowmatic Regulator. Confronted with the problem of maintaining close boiler water level control in spite of severe load fluctuations produced by forging operations, they found Flowmatic to be the correct solution. As Mr. Max R. Boye, Chief Engineer of the Power Plant, has remarked on the return card of our routine check-up, the score is now 11 Boilers, 11 Copes Flowmatic Regulators.

Proved performance of this kind accounts for the remarkable record of more than 825 Copes Flowmatic installations since its introduction only 5 years ago.



The Copes Flowmatic Regulator offers a simple reliable means of maintaining exacting feed water control geared to the requirements of modern boiler design. It is especially valuable on installations subject to severe load fluctuations. For details, write for Bulletin 429-A.

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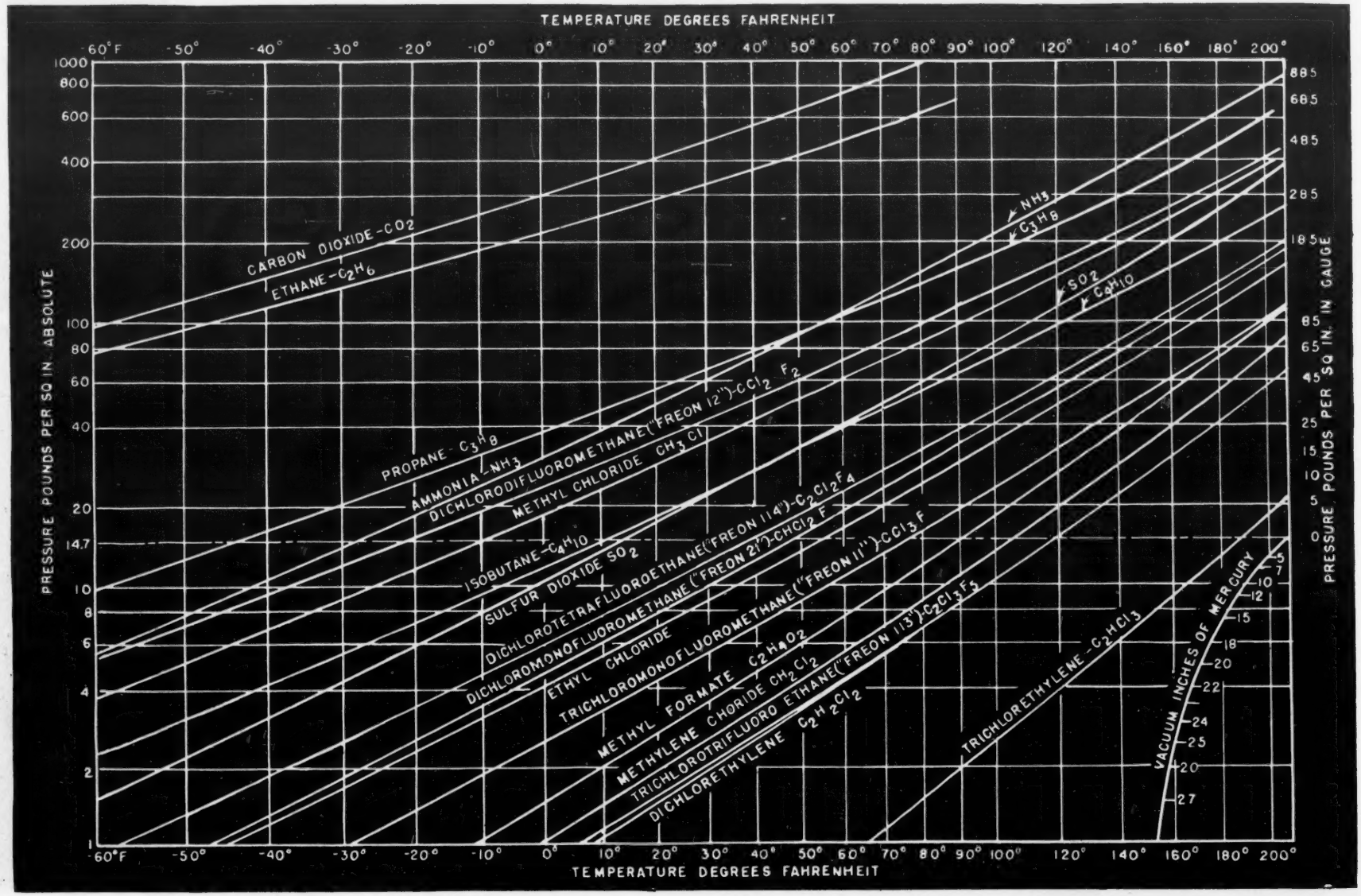
TEMPERATURE DEGREES FAHRENHEIT
-60°F -50° -40° -30° -20° -10° 0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 120° 140° 160° 180° 200°
PRESSURE POUNDS PER SQ IN. ABSOLUTE
1000 800 600 400 200 100 80 60 40 20 14.7 10 8 6 4 2 1
PRESSURE POUNDS PER SQ IN. IN GAUGE
885 685 485 285 185 85 65 45 25 15 10 5 0
CARBON DIOXIDE - CO_2
ETHANE - C_2H_6
PROPANE - C_3H_8
AMMONIA - NH_3
DICHLORODIFLUOROMETHANE ("FREON 12") - CCl_2F_2
METHYL CHLORIDE CH_3Cl
ISOBUTANE - C_4H_{10}
SULFUR DIOXIDE SO_2
DICHLOROTETRAFLUOROETHANE ("FREON 114") - $C_2Cl_2F_4$
DICHLOROMONOFLUOROMETHANE ("FREON 21") - $CHCl_2F$
ETHYL CHLORIDE
TRICHLOROMONOFLUOROMETHANE ("FREON 11") - CCl_3F
METHYL FORMATE $C_2H_4O_2$
METHYLENE CHORIDE CH_2Cl_2
TRICHLOROTRIFLUORO ETHANE ("FREON 113") - $C_2Cl_3F_3$
DICHLORETHYLENE $C_2H_2Cl_2$
NH_3
C_3H_8
SO_2
C_4H_{10}
TRICHLORETHYLENE - C_2HCl_3
VACUUM INCHES OF MERCURY
3 5 7 10 12 15 18 20 22 24 25 26 27
-60°F -50° -40° -30° -20° -10° 0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 120° 140° 160° 180° 200°
TEMPERATURE DEGREES FAHRENHEIT

Pressure-Temperature Relationships of Refrigerants
(From the 1942 Issue of the Refrigerating Data Book published by the American Society of Refrigerating Engineers)

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Air Conditioning for a Blackout Plant

Cooling the building in both summer and winter, providing close control of temperature for accurate machine work, and at the same time maintaining comfortable conditions for the working force were the principal problems in air conditioning this windowless industrial plant manufacturing airplane turbosuperchargers. Major air conditioning equipment is concentrated in three mezzanines. The design of production facilities and air-conditioning system permits 24-hr operation under favorable conditions, an important factor in war production. The electrical system, designed for maximum flexibility, incorporates the latest developments in load-center units and distribution system

THE NEW "BLACKOUT" windowless factory built by General Electric Co. in New England for the manufacture of turbosuperchargers is an attractive one-story brick structure providing several acres of production floor space. It consists of a main manufacturing section, with an attached boiler house, test, and forge shop. Located off the production floor are the production offices, rest rooms, drafting room, and dispensary — all completely enclosed.

Although speed in planning and erecting it was essential, the new plant includes the benefits of the latest in modern construction and equipment. Its design is such that it can be blacked out completely. The roof treatment lends itself to easy camouflage.

Internally, the building incorporates the latest features of modern industrial plant design. Lighting, air conditioning, and service facilities are provided for the maximum comfort and efficiency of employees. Interior walls are of buff-colored glazed tile, enclosing an open expanse with an 18-ft ceiling clearance.

Commenting on the new building, J. G. Trudinger, G-E plant engineer in charge of the design and construction, points out that "It is now possible to maintain 24-hr operations of a factory under conditions favorable to all the working shifts, a highly important factor in these days. . In addition to the complete elimination of dirt, dust, and draft in 'windowless' buildings, substantial savings may be effected in window maintenance."

Pressure cleaning rooms, etch test, grinders, and chemical laboratory are equipped with exhaust systems. The rest rooms and dispensary have their own ventilating systems, while the cafeteria is tied into the main air conditioning system.

The boiler house, test, and forge shop attached to the main manufacturing section houses several G-E electric furnaces for heat-treating metal parts. There are three integral furnace-type boilers, each of 60,000 lb per hr steam capacity at 225 psi. One of these heats the plant, the other two furnish steam to testing chambers. Near the furnaces are two large 1000-cfm air compressors for supplying air at 100 psi to production machines on the floor. These compressors are driven by two G-E 250-hp motors.

In the test section are separate chambers, mentioned above, and equipment for subjecting the completed turbosuperchargers to hot gas and steam tests under the same exacting conditions they will encounter in operation at high altitudes.

An enclosed modern substation houses transformers, switchgear, air circuit breaker equipment, as well as battery equipment to assure continuity of power supply.

Air Conditioning

Even after the snow of a New England winter lies heavy on the ground, the plant's air conditioning system will be operating for cooling.

The major portion of the internal sensible heat load in the factory consists of heating equipment and power machinery used in the manufacture of the turbosupercharger. Since the building is so well insulated, the amount of heat released by this equipment, when the plant is operating at full capacity, is sufficient to heat the building until the outdoor temperature drops below 15 deg above zero. Consequently the air distribution system has been sized and located to balance the internal load on cooling, with only small modifications at points of maximum heat release to allow for some lack of balance between heating and cooling loads.

The manufacture of turbosuperchargers involves numerous very accurate machining processes on metals which require very close control of temperature throughout the year for successful results. This was the primary factor in the design of the air conditioning system. As far as possible, however, every effort

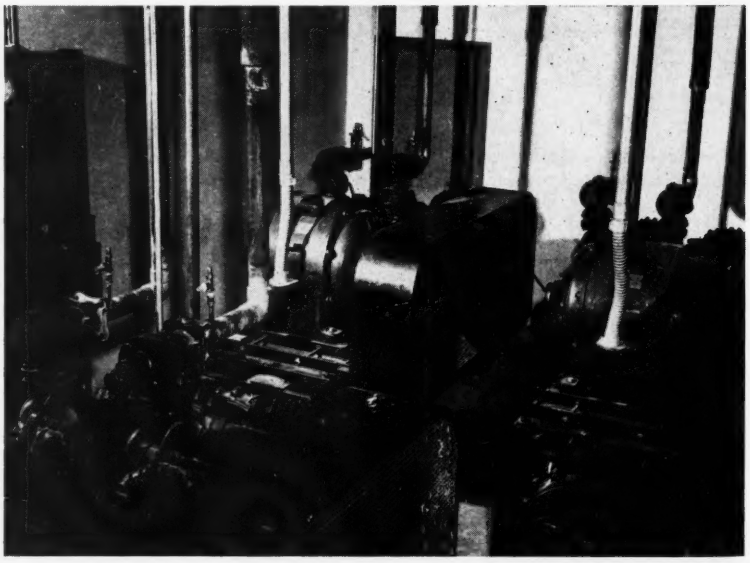


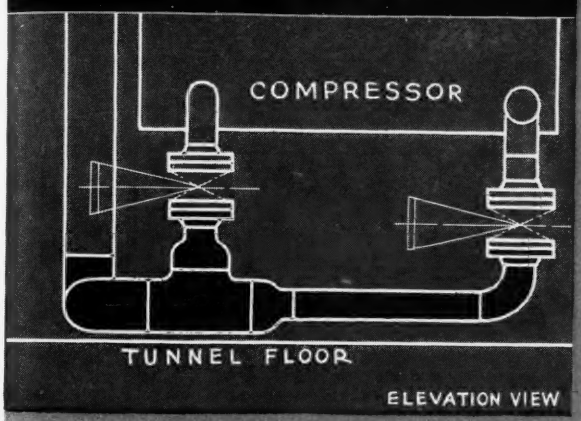
Fig. 1. One of the machine rooms of the air conditioning system. Each room contains three 8-cylinder reciprocating compressors, each driven by a 60-hp motor, providing refrigeration for direct-expansion coils

NO. 9 OF A SERIES
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

The FIRST SEAMLESS WELDING FITTINGS 1ST AND STILL THE BEST

Save 50% time by preassembling piping with TUBE-TURN welding fittings!

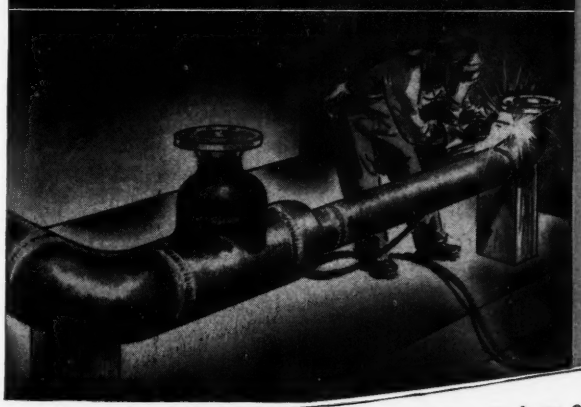
PROBLEM: Install Section of Piping into System

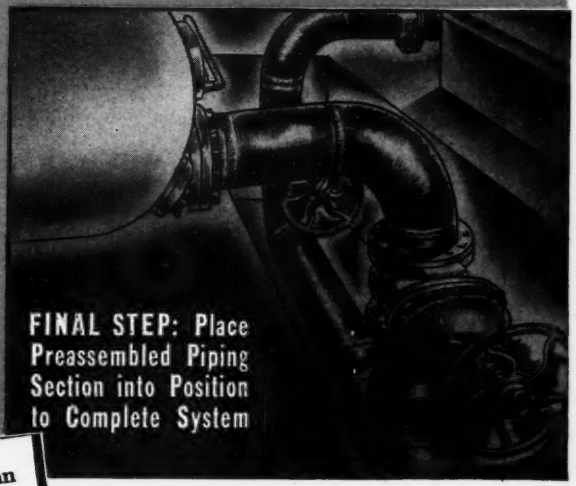


ELEVATION VIEW

1st STEP: Assemble Pipe and Tube-Turn Fittings

2nd STEP: Preassemble Section in the Shop





FINAL STEP: Place Preassembled Piping Section into Position to Complete System

PIPING welded with Tube-Turn fittings can be installed from 50% to 75% faster—thanks to faster aligning, welding and preassembling in the shop. No torch cutting or fitting fabrication necessary. Tube-Turn fittings are ready to weld —types, sizes and weights for all needs.

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Fig. 2. Vertical gear-motor driving fan with blades of molded laminated plastic on top of cooling tower

has been made to maintain, at the same time, air conditions within the comfort zone.

The air conditioning system requires hundreds of tons of refrigeration, which is provided by more than 15 General Electric 60-hp, 8-cylinder reciprocating condensing units and direct expansion coils. Six fans serve six independently-controlled zones in the plant. All major equipment is located in three mezzanines centrally located with respect to load and built into the building structure, so that all machinery, ductwork, and outlets are above the 18-ft level. Each mezzanine has two machine rooms containing the three compressors, fans, and coils for the zone served from this space.

The system is designed to produce a maximum of 11 deg of cooling at an outdoor temperature of 91 deg, but because of the high internal sensible load, the proportion of the total capacity used for temperature change within the building on cooling is relatively low. The controls are of the pneumatic type of the most sensitive kind available, for rapid changes in indoor temperature are possible with any variation in duty of the manufacturing machinery. They must be able to meet quickly, for example, the changes which occur at mealtimes and at hours when shifts change, intervals during which a considerable amount of the machinery may be shut down.

Fresh air is introduced at each mezzanine through the roof directly above at the rate of 100,000 cfm, sufficient to produce four changes per hour in the conditioned space, except during cooling or heating load peaks. At such times, it is reduced to one change per hour. Because the building has no windows and only a very few openings, full exhaust capacity for the entire amount of fresh air introduced is provided by 18 exhaust fans located under the eaves of the building. All air in the building is cleaned by automatic air filters operating continuously.

Air is distributed to the six zones through ductwork of standard construction and ceiling discharges of the venturi bowl type, located at the bottom of the building trusses, 18 ft from the floor.

Heating is accomplished with steam coils modulated in six steps for each zone and requires a maximum outlet temperature only 25 deg above room temperature under design heating conditions. The air outlets are located in the center of each 40-ft bay with a downward-angle discharge sufficient to provide a thorough mixing of the discharge air at the floor level both under heating conditions and under cooling conditions with a discharge temperature 20 deg below room temperature.

A large cooling tower of more than a 1000 tons capacity is located a short distance away from the building. Cooling water is circulated to the condensers by a steam-turbine-driven pump, the exhaust steam from which is used in the manufacturing processes. All piping is cast iron outside of the building and welded steel inside. Piping is distributed to the condensers through tunnels under the floor of the manufacturing space, with risers running up to the three mezzanines along the columns of the building.

Electrical System

The electrical system is designed for maximum flexibility of power load. Power for all electrical services is purchased from the local utility and reaches the plant by means of underground cable at 23,000 v, three-phase, 60 cycles. The incoming 23,000-v power is stepped down to 2300 v by means of three 3125-kva Pyranol cooled transformers. Power is distributed by means of 2300-v, three-phase feeders protected by breakers.

The substation — consisting of 23,000-v switchgear, transformers, and the 2300-v removable breaker metal-clad switchgear — is located in a brick and cement fireproof room in the factory proper in a location convenient for power distribution circuits.

Large motors used for air compressors, testing equipment, and transformers for resistance welding and similar service are operated directly from 2300-v circuits. These are protected by breakers in the metal-clad switchgear in the substation.

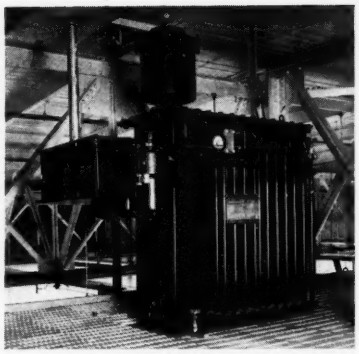


Fig. 3. One of twelve 225-kv Pyranol load-center units supplying Flex-a-power runs. Units in roof-truss spaces 18 ft above floor

Two 2300-v, three-phase feeders supply a total of twelve 225-kva Pyranol load-center power units, located in the roof truss space, which step down to the low-voltage distribution.

From the 225-kva load-center power units, power for machine tools, furnaces, lighting, and miscellaneous services is distributed throughout the factory by means of Trumbull Flex-a-power runs. Twelve Flex-a-power runs, spaced 40 ft apart, extend the complete width of the factory, each supplied by its own power unit. Of the latest type, this busbar system permits relocation of machinery easily and without costly repairing and reinstallation of wiring.

Air conditioning and heating equipment is supplied by one 2300-v feeder circuit controlled from the metal-clad switchgear. This circuit supplies three 350-kva Pyranol transformers located at each of the three air conditioning and heating mezzanines, stepping the power down to 550 v, three-phase, for the motor equipment driving compressors and fans.

Three-phase, 230-v lighting circuits for double-unit 100-w fluorescent lighting are taken from the general power distribution at convenient points.

Provision has been made with space and conduits so that it will be possible to install an additional incoming power cable from the power supply over a separate route, if necessary in the future.

Auxiliary emergency lighting for use in case of a power failure is supplied from storage batteries in sufficient amount to allow safe passage throughout the factory.

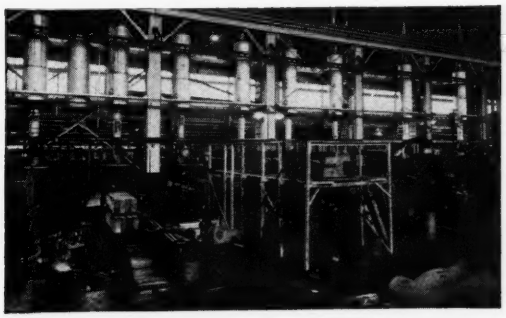
BURGESS SNUBBER BULLETIN on Diesel Exhaust Noise Control

Burgess Snubbers in the War

The Snubber Bulletins which appear on this page have not often shown naval vessels, army power plants, or other direct war applications. Photographs of such installations are usually difficult or impossible to obtain under the necessity for wartime secrecy, but it is possible to show some of these units, most of them developed to meet a specific need of the Army or Navy.

The picture at the right shows a number of Burgess products designed for special service since the beginning of hostilities. Most of these are intake silencers; the four units across the bottom of the picture being the only exhaust units shown. The exhaust units are engineered on the well-known Burgess snubbing principle, while the intake units generally utilize other patented Burgess acoustic constructions.

★ ★ ★



Test stands at Cooper-Bessemer Grove City plant equipped with Burgess Snubbers.

QUIETING TEST STANDS' EXHAUSTS

Engine manufacturers with large numbers of engines running on test simultaneously have an unusually difficult problem of exhaust noise quieting. In one plant draftsmen were forced to work in a constant roar of noise because engines were exhausted into an areaway below them, and the mufflers used did not provide sufficient quieting. The installation of a row of Burgess Snubbers on these engines solved the problem.

The difficulty of controlling exhaust noise on test stands is complicated by the fact that flexible couplings and other temporary hook-ups mean that a set exhaust pipe length cannot be maintained for every engine under test. Therefore, old-style exhaust mufflers often vary greatly in the degree of silencing which they provide.

One of the requirements of exhaust quieting devices on these test stands is that they must not in any way impair the operating efficiency of the engine. If efficiency were interfered with, the engine would not be undergoing a fair test.

It is significant, therefore, that a great many engine manufacturers have equipped their engine test stands with Burgess Exhaust Snubbers. The Cooper-Bessemer Corporation, Waukesha, Hamilton, Buda, General Motors, Fairbanks-Morse, and many other engine manufacturers have installed Burgess Snubbers on their test stand exhausts.

This is another example of the way in which Burgess Snubbers have been able to meet stringent requirements for quiet, because they can be installed without regard to exhaust pipe length or location.

★ ★ ★

MINE SWEEPER The YMS-241 is one of twelve mine sweepers being built by the Tacoma Boatbuilding Company. It will be used to clear safe channels through mine fields for larger and more heavily armored craft.

Burgess Exhaust Snubbers and Intake Silencers are used on these boats, as well as a Burgess Acousti-Booth in the engine room.

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All Over But The Shooting

(Editorial Comment)

THIS WAR is all over but the shooting. It is not, however, all over but the shouting. And the shooting will have to go on for a long time—perhaps longer than necessary—because the country as a whole is not keeping its war production in step with the increased pace of the war. It is taking too much time out for shouting and admiring itself.

The one thing you hear most from men returned from the fighting fronts is "The equipment is fine—but we need lots more of it."

We are now in the position of the champion prize-fighter who is rapidly wearing down his opponent. We have seen what happened to many a champion who eased up at that point. A sudden wild swing from the losing man caught the champion on the jaw. Can we afford to take such a chance?

One of the principal causes given for our lagging production is manpower shortages. And it has just been announced that production schedules will be cut in areas of critical labor shortages. Where, then, and how, will they be increased to keep the production curve going up at its former rate, as it must if we are to win the war soon? That will be up to every one of us—labor, management, engineers, every individual in the country.

For one of the clear causes of our growing success in the war has been our increasing production power. We must continue to increase its effectiveness if we are to win an early and complete victory.

Power engineers, who literally turn the wheels of our great war production machine, must use every bit of their foresight and energy to solve the manpower, material and management problems of their own industry. So far, power has never been "too little and too late." Let's make sure it never will be.

Finally, power engineers can lend important support and help to the production men who must get the output curve going up again. Be sure they understand, as all power engineers do, that the way to solve the problem is to find out what's wrong, how important it is, what can be done—and then help them do it.—C. R. E.

Coal Research Program Approved

H. N. EAVENSON, president of Bituminous Coal Research, Inc., has announced approval by the board of directors of a new five-year, $2,500,000 research program. The directors of the bituminous industry's research agency followed recommendations of its Technical Advisory Board in reaching its decision in a meeting on September 10 at Battelle Memorial Institute, Columbus, Ohio, where an extensive program is already in progress. The announcement assures the continuation of the program started in 1935 by the coal operators to utilize the country's coal reserves and thus to conserve declining reserves of oil and natural gas.

The half-million-dollar-a-year undertaking aims to rid the skies of coal smoke through complete combustion in apparatus ranging from small smokeless, cabin heaters to large industrial furnaces. The principles have been demonstrated at the Battelle laboratories, where new forms of stoves, furnaces, and firing apparatus are taking shape to aid fuel utilization during the war and in the postwar future.

Twelve major research investigations involving over ninety specific topics and affecting the consumption of virtually the entire annual bituminous coal production, which is scheduled to reach 600 million tons this year, are contemplated to make coal the preferred of modern fuels.

Cooling of residences in the summer by the same coal furnace that heats it in the winter, conversion of coal into gas without byproducts, and household stokers that automatically take coal from the bin and put the ashes into containers are among the leading subjects scheduled for investigation. Coal-fired railroad locomotives which operate over longer distances without stops for fuel and water will be possible through improved combustion in radically new designs.

Coal-burning heaters and ranges that heat steadily all day and night without smoke and with only infrequent attention and one rekindling a season are to be perfected. To insure that stoves, stokers, and furnaces will meet with public satisfaction, high standards of performance will be sought through the adoption of rating codes and tests of these manufactured products. Chimney construction will be given attention to help architects eliminate faulty designs.

"Fluid coal", a suspension of finely pulverized coal that burns like gas in a hot furnace, is slated for further tests to enable coal to replace oil and gas in the furnaces of war factories.

While finely pulverized coal has also been burned experimentally inside special "orange-hot" alloy steel tubes, the commercial development of this high-temperature heating element for heat-treating furnaces will be undertaken as part of the new program. The particular advantage of indirect heating in this manner lies in keeping the gases of combustion from the product being heated.

The research also includes experimentation with pulverized-coal-fired internal combustion engines and gas turbines for the production of power and the propulsion of locomotives and ships. An investigation of coal as an ingredient in brick manufacture, synthetic rubber production and in agriculture will also be undertaken.

Ashes will be given a major share of attention in proposed studies of burning coal in industrial boiler furnaces. The ashes can often best be removed as fluid slag or partially fused, solid pieces, but the principal difficulties to be overcome are the adherence of sintered and fused ash on the inside of the combustion furnaces and the escape of a small proportion to the atmosphere.

The main objective of a project on the production of chemicals from coal is the production of an ash-free liquid, probably by hydrogenation, which then could be processed by subsequent treatment to yield a variety of materials for various industries. Among the products to be obtained in this way would be tar acids, a basic ingredient for the plastic industry, and solvents. It is now known that by hydrogenation, coal yields at least ten times the quantity of tar acids that can otherwise be obtained from the same coal.

For low cost power in stationary service installations, Baldwin Diesel Engines have an outstanding record of economical operation and maintenance the country over.

Baldwin has built diesel engines for practically every application. They provide unfailing low cost power in ice plants, industrial and commercial plants, textile, cotton oil, and flour mills, public buildings, hotels, and colleges. Recent statistics on one Baldwin Diesel installation showed a maintenance cost for replacement parts of 5c per horsepower per year over a ten-year period.

The knowledge and experience gained in 49 years of diesel engine manufacturing is built into every Baldwin Diesel. Whatever your power requirements, regardless of the type of service, it will pay you to consult Baldwin. The Baldwin Locomotive Works, Philadelphia, Pa.

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BALDWIN

DIESEL ENGINES

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This flexible coupling between motor and operating hose permits greater angular movement of the cleaner in curved tubes.

No more stiff, worn or oil soaked short sections of hose. No more restricted flow of air due to swelling and deterioration of hose. This new all metallic coupling permits whole unit to be stored in oil. It is sturdy, practically wear proof, and streamlined.

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YOU FACE TWO PROBLEMS . . .

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Engineered for efficiency and economical operation—ruggedly built to give years of hard service—"F&E" Underfeed Stokers will give you the kind of fuel-burning equipment that is essential to profitable and successful boiler-room operation.

If your steam requirements are as high as 40,000 lbs. of steam per hour or as low as 1000 lbs. of steam per hour . . . whether your boilers provide power or heat . . . investigate the advantages that coal-burning "F&E" Stokers offer. Write for the "F&E" story now . . . learn the "whys and hows" . . . and you will specify "F&E" with utmost confidence.

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Representatives in Principal Cities

This combination of operating features is your assurance of economy, efficiency and dependability . . .

1—"F&E" ELECTRO-HYDRAULIC DRIVE*
2—"F&E" INTERVAL TIMER GOVERNOR (patented)
3—SLIDING BOTTOM RETORT
4—FUEL BED REGULATOR
5—HIGH EFFICIENCY TUYERES
6—REMOVABLE RAM CASE LINER

* Steam Drive available

Plus

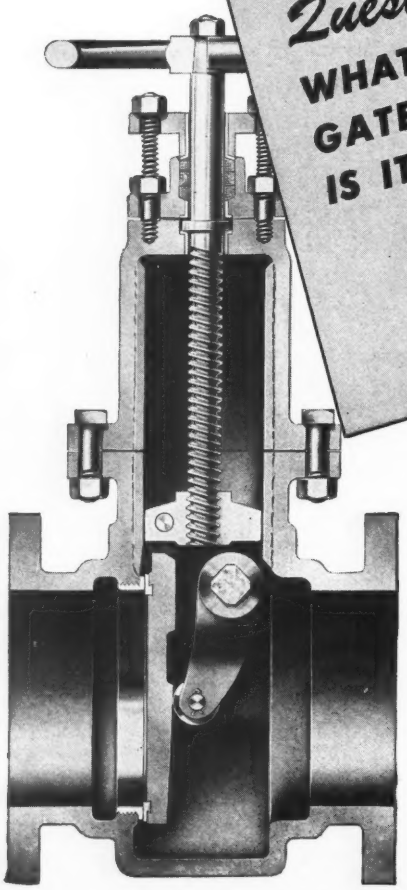
Universal acceptance by exacting mechanical engineers and users

Plus

Enviable performance records as proved by evaporative tests during actual operation.

Do You Know About ALL the DIFFERENT TYPES OF VALVES?

TODAY, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you specify a valve for that all-important line, be sure it is "the best buy" for the application . . . not just another valve. There are special types of valves which may be unknown even to many experienced engineers. For example, would you be able to answer this question?



Question:

WHAT IS A SAFETY SWING GATE VALVE, AND WHERE IS IT USED?

Answer:

This unique design . . . the Kennedy-Erwood Safety Swing Gate Valve . . . combines the functions of a gate valve, check valve, and relief valve in a single unit. It may be hand-operated as a standard gate valve, but when closed, the adjustable spring-controlled disc will automatically relieve excessive unbalanced pressure in any apparatus or pipe line.

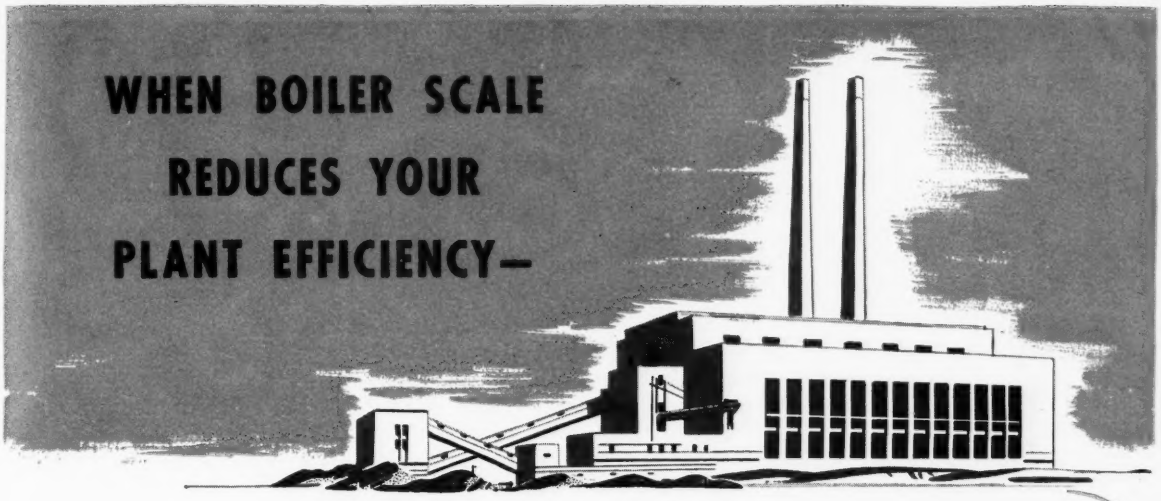
For example, used as a non-return valve on exhaust line between turbine and condenser, this valve protects the low-pressure casing against building up of pressure which might cause failure and serious damage to equipment. Also used as a back-pressure valve, atmospheric relief valve or safety gate valve on pumps, compressors, etc.

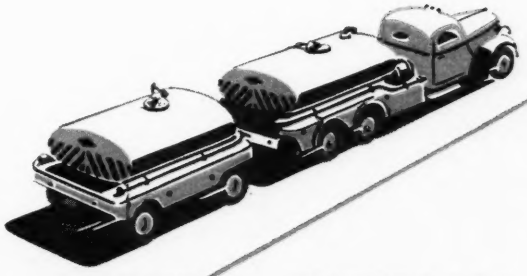
If you have a valve selection problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

KENNEDY VALVES • PIPE FITTINGS • FIRE HYDRANTS
THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

WHEN BOILER SCALE REDUCES YOUR PLANT EFFICIENCY—





DOWELL CHEMICAL SERVICE

WILL REMOVE THE SCALE *QUICKLY* AND *COMPLETELY*

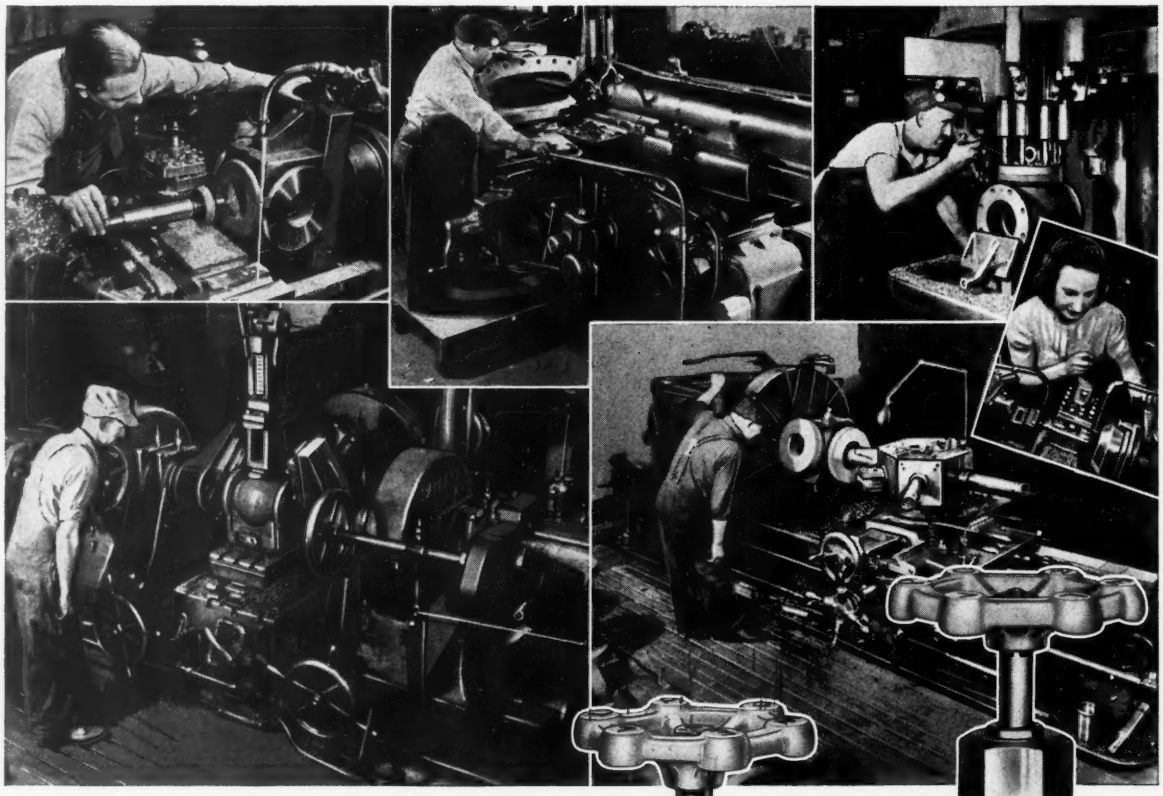
THROUGH CHEMISTRY has come a better, more effective way of removing scale from heat exchange surfaces. Dowell Incorporated, together with its parent company—The Dow Chemical Company, has developed and perfected a *chemical* method of removing boiler scale, quickly and completely.

This Dowell method is the *fastest, safest* and most *efficient* ever devised for removing water deposited scale from all types of heat exchange surfaces. It does a better job than either mechanical or manual methods and does it in just a few hours where the old-fashioned practices took days. It saves precious time— it keeps vital power equipment operating at peak wartime production.

If you are looking for more boiler capacity and less time off the line—let us give you the complete story about Dowell Chemical Scale Removal Service. Wire, phone or write our general offices in Tulsa—there's no obligation.

DOWELL INCORPORATED
Kennedy Bldg., Tulsa, Oklahoma
Subsidiary of The Dow Chemical Company

Look to
DOWELL
FOR INDUSTRIAL CLEANING AND SCALE REMOVAL SERVICE



Final Preparation for a long, useful life!

With the skill born of long experience, **POWELL** craftsmen "finish" the product that will honor the family motto—"Standard for Control." These valves started their career from the point of an engineer's pencil—part of the process of POWELL's creative cooperation with technical and maintenance staffs. In every process of manufacture these valves have been tested to POWELL's pre-determined requirements for material, function, longevity . . . to the letter of the law of POWELL's specialized manufacture of valves and nothing but valves.

The Wm. Powell Company

Dependable Valves since 1846

Cincinnati, Ohio

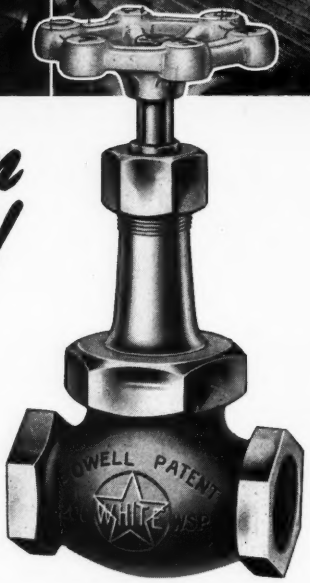


Fig. 1708—Bronze Globe Valve for 200 pounds W. P. Has screwed ends, union bonnet, renewable seat and regrindable, renewable hard bronze semi-cone plug type disc — especially adapted for throttling service—for the control of low-pressure steam, oil, water, gas, etc.

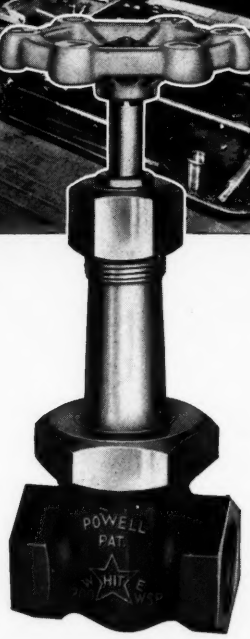


Fig. 375—Bronze Gate Valve for 200 pounds W. P. Has screwed ends, union bonnet, inside screw rising stem and a special hard bronze disc.

POWELL VALVES

Silent exhaust *means* more efficient man-hours . . .

It is well recognized today that excessive noise can be an important factor in reducing the efficiency of plant personnel. Maxim Silencers can reduce engine exhaust roar to a whisper, thus eliminating one of the most penetrating and nerve jangling rackets present in plant operation.

To the organizations unable to secure high enough priority ratings to get Maxim Silencers today, The Maxim Engineering department offers a consultation service that can often result in quieter operation of your present equipment. Simply give full details and write to The Maxim Silencer Co., 92 Homestead Ave., Hartford, Conn.

MAXIM WASTE HEAT UNITS SAVE FUEL

Descriptive Bulletins WH-100, WH-102, WH-103, on request

MAXIM

WARTIME ENGINEERING SERVICE

"KNOW HOW!

TO GET THE MOST OUT OF YOUR *Packings*"

With materials shortages, the Packing Industry faces a difficult task—to supply Industry with packings so vital in our War Effort. Naturally this is being done, but not without difficulties promoted by present conditions.

Under these circumstances, knowing how to get the most out of your packings takes on new importance. Through proper packing, conserved wisely, machines can be kept running efficiently at less cost. 'Know How' simplifies packing difficulties; points the ways and means to conserve vital packings; and, reduces packings problems to a minimum.

To help you get the most out of your packings, Belmont Packings, as a service to you, suggest below ways to make your packings last longer:—

1. CONSERVE PACKINGS—When repacking, it may be found that a few rings of new packing inserted next to the gland may give added service. This will mean conservation of old packing retained in the stuffing box.

2. LUBRICATE MOVING PARTS—Keep rods, shafts and plungers thoroughly swabbed with oil or grease to alleviate frictional wear on packing. Where practicable, install oil lanterns.

3. CHOOSE SUBSTITUTE CONSTRUCTIONS—When material shortages make your desired type not instantly available, consult with your nearest Belmont distributor or with us for guidance on this question.

4. REFER TO THE BELMONT CATALOG—It's an invaluable packing guide of complete information on packings for all services... it contains informative charts; clearly illustrates and describes every Belmont packing; and suggests varied packing styles from which to choose a substitute packing, if necessary. Write on your Company letterhead for your copy.

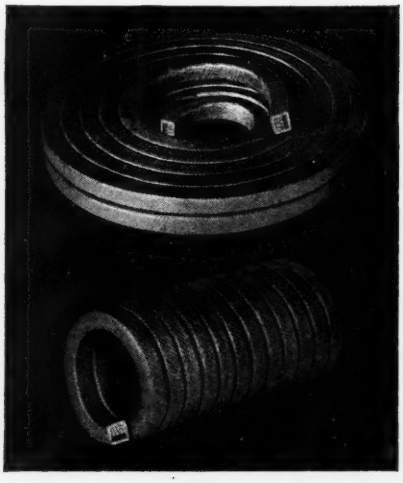
BELMONT PACKINGS

The Belmont Packing & Rubber Co.

Butler and Sepviva Sts., Philadelphia 37, Pa.

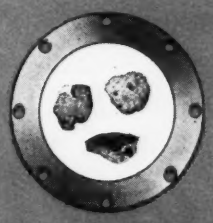
THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

There's a Belmont Packing for every service... Steam, Water, Oil, Gas, Air, Acid, Alkalis, and Ammonia. Forms include Rings, Coils, Spirals, Reels, Spools, Sheets, and Gaskets.

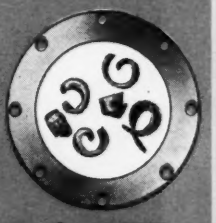


LOOK HERE FOR VALVE SABOTEURS!

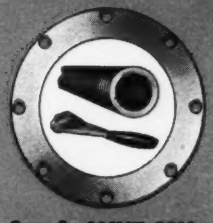
Prevent Valve Failure *before it starts!*



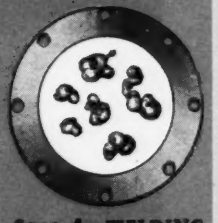
Case 1. PIPE SCALE clogs valves. *Prevention:* blow out or flush pipe thoroughly.



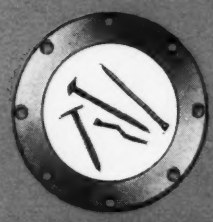
Case 2. PIPE CHIPS ruin valve seats. *Prevention:* Clean threads before connecting pipe.



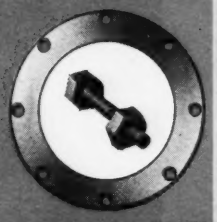
Case 3. JOINT COMPOUND clogs valves. *Prevention:* Put it on pipe threads only.



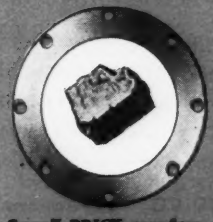
Case 4. WELDING BEADS ruin valve seats, prevent closing. *Prevention:* Blow out or flush pipe.



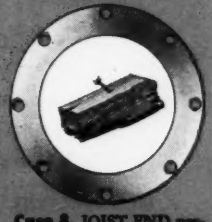
Case 5. NAILS jam seating gate valve. *Prevention:* Instruct workmen to clean lines.



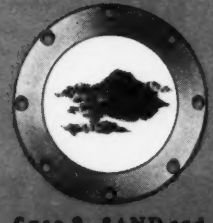
Case 6. BOLT and NUT lodge in gate valve seat. *Prevention:* Instruct workmen to be careful.



Case 7. BRICK stops flow through line. *Prevention:* Look before closing line.



Case 8. JOIST END prevents check valve closing. *Prevention:* See that new lines are clear.



Case 9. SAND and GRAVEL wear out valve parts. *Prevention:* Flush out lines.

Case 10. NEWSPAPERS foul a check valve. *Prevention:* Make sure lines are clear.

SAVE VALVES... *Keep War Production Moving... See that Pipe Lines are* CLEAN *before they are closed*

Records show that every one of these valve saboteurs has been caught in a pipeline . . . left there during installation or repair work. All have caused crippling shutdowns . . . some have ruined valves beyond repair.

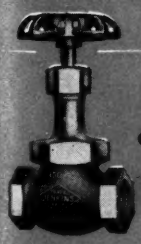
To guard against the constant threat of damage by these valve enemies, workmen must be taught to look into, and *through* every unit of a system before it is connected up. As a further precaution, thorough flushing or blowing out before the system is put into service is recommended.

Time lost in production slowdowns today interrupts the flow of vital war material to our fighting forces.

Slowdowns due to valve failure can be prevented, waste of critical valve metals greatly reduced, by effective valve conservation. See that your valves get frequent, systematic inspection. Repair or renew worn parts before a valve destroys itself. When valves must be replaced, have the new valves selected and installed by experienced men. Above all, train new workers to operate and maintain valves properly.

Consult Jenkins Engineers for any assistance you need in promoting valve conservation.

Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport, Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.



JENKINS VALVES

SINCE 1864

For every industrial, engineering, marine and power plant service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys...125 to 600 lbs. pressure.

GLOBE STEEL TUBES

Strength with minimum weight — uniformity of structure and characteristics — easy machine-ability — adaptability to a wide range of needs — these are a few of many advantages of Globe Steel Tubes that have given them an important place in the construction of all types of military equipment.

GLOBE STEEL TUBES CO. • Milwaukee 4, Wisconsin

- Boiler & Pressure Tubes
- Condenser & Heat Exchanger Tubes
- Mechanical Tubing
- Stainless Tubes (Seamless)

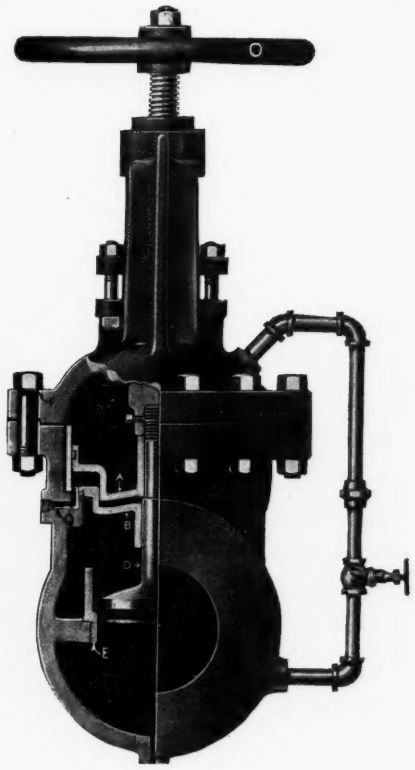
GLOBE TUBES

- Stainless Tubes (Seamless)
- Glaweld Tubes (Welded Stainless)
- Globeiron Tubes (Seamless Pure Iron)

Carbon — Alloy — Stainless Steels

GOLDEN-ANDERSON

SPECIALTY VALVES



Throttle and Emergency Stop

★

Recognized by turbine and engine manufacturers and plant operators alike as one of the most dependable valves of its kind, the G-A Throttle and Emergency Stop Valve offers positive protection against runaway turbines and engines.

OPERATING SEQUENCE: With by-pass valve opened, and trip pilot control valve reset in its closed position whenever handwheel stem is run up, the valve will automatically open to admit pressure into engine or turbine.

On overspeeding of engine or turbine the shaft governor may directly operate trip pilot control valve or limit switch, if solenoid trip pilot control is used, to open trip pilot control valve and permit engine stop valve to instantly close and stop engine or turbine.

By running down handwheel stem the valve may be closed whenever desired, and by-pass valve should be closed when the valve is to be maintained in closed position over a period of time.

The G-A Throttle and Emergency Stop Valve is available in working pressure capacities from 250 to 1500 lbs.—sizes, 2½" to 16".

Information on all G-A Specialty Valves is readily available . . . write for our catalog today!

Also

Triple-acting Non-Return . . .

Pressure Reducing . . .

Throttle and Emergency

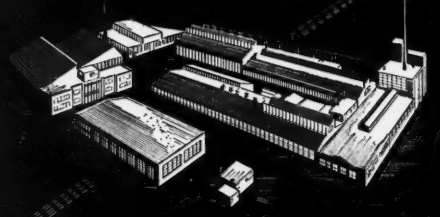
Stop . . . Check valves, etc.

GOLDEN-ANDERSON SPECIALTY VALVE CO.

FULTON BUILDING • PITTSBURGH, PA.

One purpose ···

the IMPROVEMENT of Metals



Handhole Cover Forging, typical of a full line of handhole and manhole covers and other Diamond Boiler and Tank Accessories fabricated completely by this company.

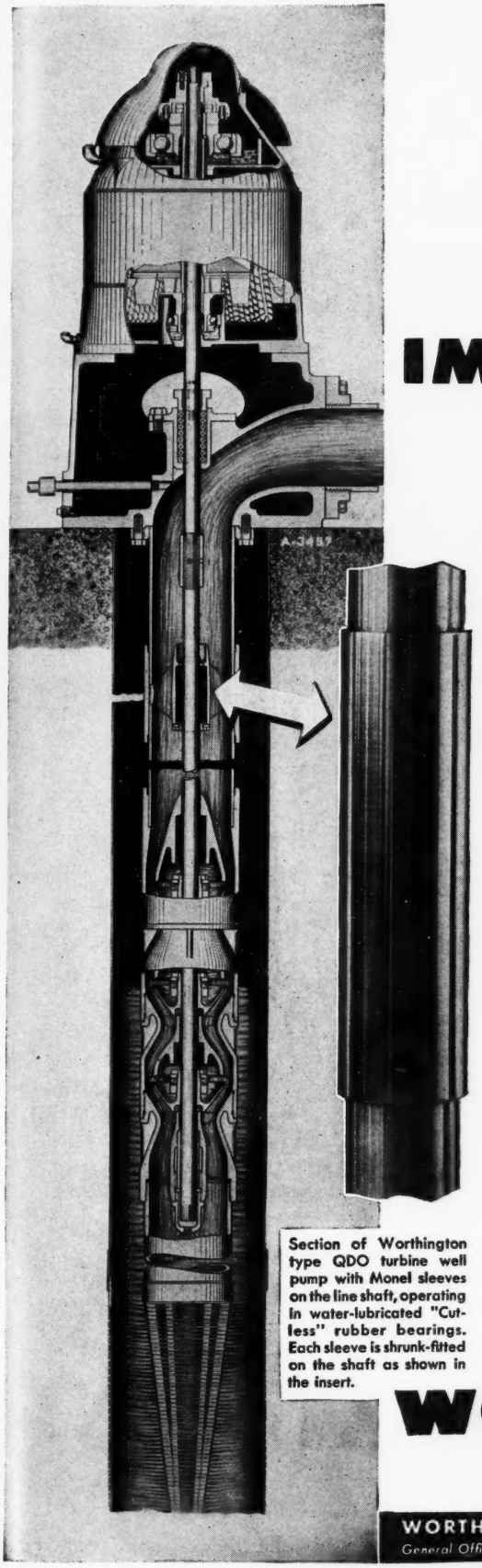
by Forging

Check over all the advantages that forgings offer for the betterment of power plant operations. Further improvement of power plant equipment, will be achieved only by detecting and utilizing, available ideas and experience, for designing and producing metal parts, which provide the greatest factor of safety. It is not the metals of which forgings are forged, but the ideas and experience, which come into action in forming forgings, that assure and sustain dependable performance. Manufacturers of power plant equipment should find it profitable to utilize the ideas and experience, which our forging engineers have gained, for THE IMPROVEMENT OF METALS BY FORGING.

DROP

THE STEEL IMPROVEMENT & FORGE CO.

FORGINGS *966 East 64th Street* CLEVELAND, OHIO



Section of Worthington type QDO turbine well pump with Monel sleeves on the line shaft, operating in water-lubricated "Cutless" rubber bearings. Each sleeve is shrunk-fitted on the shaft as shown in the insert.

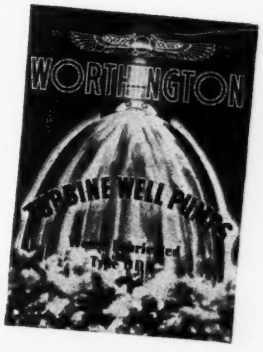
LUBRICATED BY WATER YET IMMUNE TO RUST

Worthington guards against corrosion and abrasion in its turbine well pump installations by using Monel sleeves on the line shafts at every bearing, to combine strength and toughness with resistance to corrosion and abrasion.

In Worthington water-lubricated turbine well pumps Monel shaft sleeves operate in "Cutless" rubber bearings installed at 10 foot intervals. This type of construction eliminates the necessity for a line shaft made entirely of a costly non-corrosive alloy metal.

In the Worthington turbine well pump line there is a type to meet YOUR requirements, whether your conditions call for water or oil lubrication.

These units are the product of the WORLD'S LARGEST PUMP BUILDER . . . one of America's pioneers in deep well pumping equipment.



FOR FULL DETAILS SEND FOR BULLETIN H-450-B29

WORTHINGTON

DW3-3

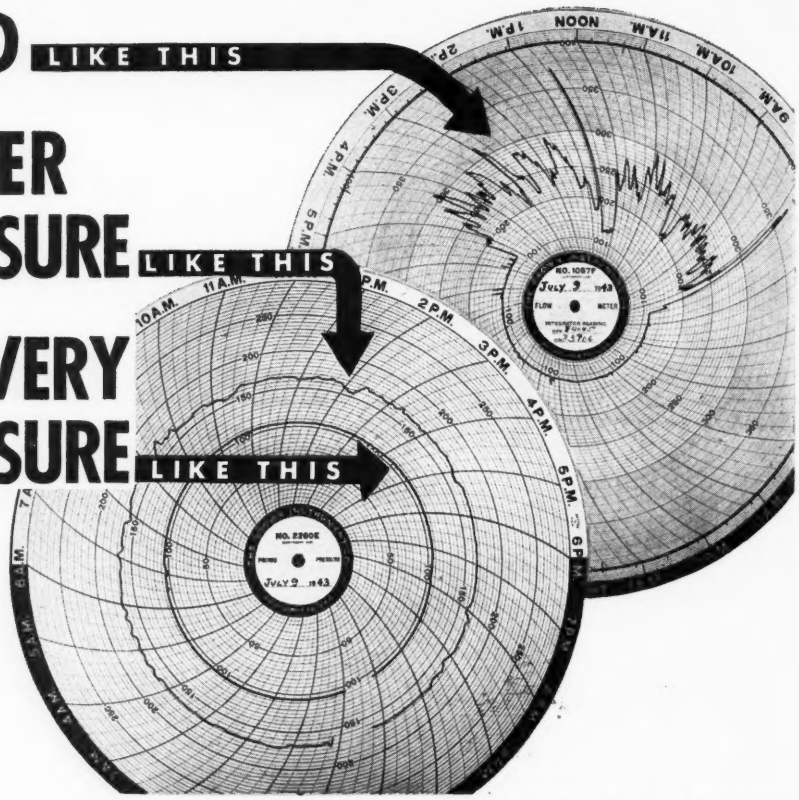
WORTHINGTON PUMP AND MACHINERY CORPORATION

General Offices: HARRISON, NEW JERSEY • *Offices and Representatives in Principal Cities*

WITH A **LOAD** LIKE THIS

AND **BOILER PRESSURE** LIKE THIS

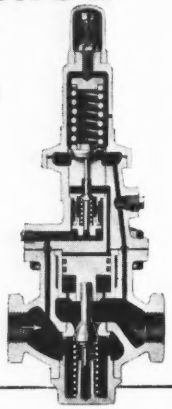
YOU GET **DELIVERY PRESSURE** LIKE THIS

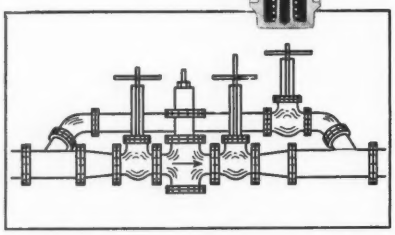


WITH A FOSTER PRESSURE REGULATOR LIKE THIS

FOSTER TYPE 37-G2 PRESSURE REGULATORS

- initial steam pressures up to 1500 pounds
- delivery pressures up to 1200 pounds
- total temperatures up to 900°F
- auxiliary or pilot operated
- wide variety of spring ranges
- alloys to suit pressure and temperature





Typical installation for a Foster Type 37-G2 pressure Regulator. Catalog 70 shows many other installation suggestions and illustrations, including proper control connections and by-pass arrangements.

PERFORMANCE such as this would be considered *good* for a *new* valve—but this 3 inch Foster Type 37-G2 has been in continuous service on a process steam line for over 15 years. Maintenance during this time has consisted of routine checkups and grinding of the pilot valve not oftener than once a year. No parts have been replaced.

This valve is giving satisfactory regulation because it is the right size and type for the job and it was properly installed.

You can count on an equally satisfactory solution to your own pressure reducing problem. Select the proper size and type of valve to fit your requirements and see that it is correctly installed. Our engineers will be glad to help you find the *right* answer—without obligation of course.

Illustrated catalog on the complete Foster line with many pages of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

111 MONROE STREET • NEWARK 1, N. J.

10-FE-1

CRYSTOLON Brick for Boiler Furnaces

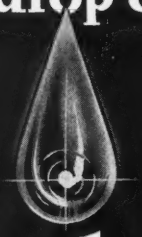
A REFRACTORY LINING WHICH PAYS DIVIDENDS

CRYSTOLON (SiC) Brick are paying dividends to power plant operators by insuring longer service and fewer and briefer shutdowns. Their dense surface cannot be penetrated by slag, making removal of the clinker ring a short, easy operation. CRYSTOLON Brick withstand high temperatures at peak operation and they are chemically inert. Their ruggedness makes them resistant to abrasion such as the motion of the fire bed.

NORTON COMPANY
Worcester, Massachusetts

Norton ELECTRIC FURNACE FUSED Refractories

Just a drop of water-



harmless...

or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

WATER CONDITIONING SYSTEM

TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

For your own satisfaction, investigate the new TECHNICAL System . . . Nature's own conditioning method developed under actual industrial operating conditions. Without obligation the coupon below will bring you the facts.

WATER TREATMENT COMPANY OF AMERICA

1159 Hodgkiss Street · Pittsburgh, Pa.

☐ Please send the new Technical System bulletin.
☐ Haye a Water Treatment Company engineer call.

Name_____ Title_____

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Address_____

Selecting Short-Circuit Protection for L. V. Motor Circuits

(*Continued from page* 81)

Generally, the use of an oil-immersed combination starter with a high-grade breaker instead of fuses is justified since it is much easier to close the breaker by an external handle than it is to drop an oil tank to replace blown fuses.

EXPLOSION-PROOF ENCLOSURE

Because of the very high pressure which may develop from a fuse blowing in the presence of gas in an explosion-proof enclosure, conventional cartridge-type fuses are unsafe when so enclosed, and therefore are not permissible except for control circuits in very small sizes. Even if this were not so, the inconvenience of replacing a fuse, because of the large number of bolts in the cover of an explosion-proof case, would make fuses undesirable. An air circuit breaker will not seriously increase the pressure when it interrupts fault current and is therefore the best available means of obtaining short-circuit protection under these circumstances (Fig. 6). The type of breaker which may be used depends upon quality acceptable and interrupting capacity required.

Summary

The fuse evidently has a definite and well-established superiority in several respects in modern low-voltage practice. Although in a large percentage of cases it affords the best protection for low-voltage motors and control equipment, it is recognized that consideration of many different factors which may be involved, such as oil immersion, special types of enclosures, available space for installation, ease of restoring service, complete circuit isolation, and frequency of fault occurrence, often leads to the selection of the circuit breaker as the most practical device under such conditions.

The magnetic breaker, though useful chiefly for low-voltage feeder and branch circuits and somewhat slower in action than a fuse on high overcurrents, is recommended for motor short-circuit protection where its higher cost is not a disadvantage.

Obviously, careful consideration is necessary in determining when and where to choose fuses or circuit breakers for short-circuit protection on low-voltage motor circuits. This discussion of their relative merits should assist in the exercise of good judgment in making the choice.

Scovill Tube News

SCOVILL MANUFACTURING COMPANY, Waterbury, Conn.

Factors Affecting War-Time Efficiency of Condenser and Heat Exchanger Tubes

The widespread use of copper and copper alloys in heat exchanging equipment is due in some measure to the many favorable physical properties of these materials, i.e., their ductility, toughness, strength, high thermal conductivity, etc., over a wide range of temperatures and pressures. The excellent corrosion-resistance of the copper alloys under most operating conditions, however, is of major importance in this application. The ability of copper and its alloys to withstand the corrosive action of such media as fresh and salt waters, sewage, hydrogen sulphide, acids, alkalis, etc., is of a high order and has established their value in tube form in contact with corrosive media. They have proved their dependability and economy under such conditions as well as under wide fluctuations of temperature, pressure and velocity of the circulating media.

Serious corrosion of condenser and heat exchanger tube does occur, however, particularly when corrosive conditions are admittedly very severe and such corrosion may result in considerable expense, costly delays and shut-down of equipment. In many cases, no improvement in tube life can be expected under existing conditions; in other cases, however, it has been possible to reduce or retard corrosion materially and obtain improved tube performance either by slight changes in operating conditions, by attention to certain operating details or by a change from one tube alloy to another which is more corrosion-resistant to the particular service conditions. For this reason, an appreciation of the factors which contribute to corrosion of tube materials is often of value to a better understanding of corrosion problems; this knowledge, in turn may be used to advantage in combatting such problems and in improving tube life. The subject is considered of sufficient importance to tube users to warrant discussion of the more important matters pertaining to corrosion problems.

"Service in Manuals" Designed for Scovill Customers Now Freely Available to All War-time Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many war-time firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors.

The Composition of the Alloy

The nonferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Scovill offers a complete range of tube alloys.

Muntz
Admiralty
Phosphorized Admiralty
Red Brass
Deoxidized Copper
Arsenical Copper
Aluminum Brass
70-30 Copper-Nickel
80-20 Copper-Nickel

Each of these has special characteristics which make it particularly suitable for use under certain conditions.

Scovill can place at your disposal the advice and consultation of men with years of experience in practical tube problems.

A Scovill tube material or method of installation may be of aid to you in obtaining longer tube life.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

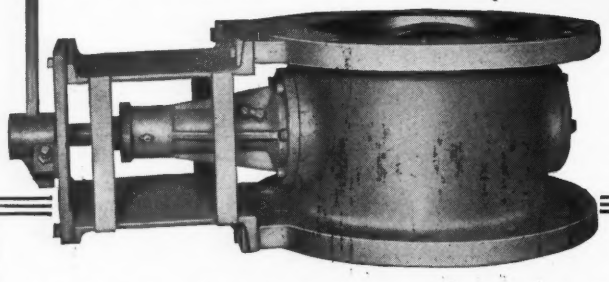
ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Wide Range of Operation

15 to 900 psi

No. 573
125-lb American Standard
—hand lever control with
extended stuffing box.



Consider the wide operating range of R-S Butterfly Valves. They are used for the reduction and regulation of pressure whether above or below atmosphere; to control liquid level; to relieve pressure and control back pressure; to maintain a constant differential pressure; to control rate of flow; to control combustion automatically as well as govern the output of pumps, fans, engines and turbines.

Coupled with these many uses and the inherent advantages of the R-S Butterfly Valve, are special metals for use where hard wear and severe stresses are encountered or where extreme temperatures and corrosive conditions exist. A further inducement to longer wear is the design of the valve itself. When the Butterfly vane approaches a closed position, the flow "fans out." There is no damaging "jet" effect to cause severe wear to the sidewall within a small area.

No. 586—A big 60-inch,
15-lb power-operated valve.

If your problem has to do with the control and shut-off of volume and pressure, and you are interested in simplified and less costly methods, write. Ask for R-S Catalog No. 14-B.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

Stop That Leak!

(*Continued from page* 85)

no one knows just what has happened except that steaming conditions are getting worse and worse.

Now suppose we install a simple inclined tube draft gage like that shown in Fig. 5, connected with "A" to the furnace and "B" to the last pass; "A" gives the draft over fire which is the operating draft, with valve 1 open and valves 2 and 3 closed. Then "B" gives the draft in the last pass with valve 3 open and with valves 1 and 2 closed. Their combination gives us "C" or draft loss between last pass and furnace with valve 1 closed and valves 2 and 3 open.

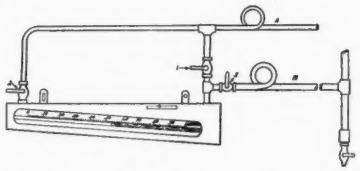


Fig. 5. Type of draft gage commonly used on boilers of small to medium size

Thus with the boiler in Fig. 4 tight and in good working order, the operator soon knows his furnace and last pass drafts and draft loss, also the approximate flue gas temperature of 550 F in the outlet of the last pass. He quite likely has high CO_2 readings with which he becomes familiar. Any increase in the flue gas temperature can mean only one of two things—dirty flues or broken baffle. One a minor and the other a major defect. Either of these may have no effect on the CO_2. A draft gage will not cure either one, but with the operators acquaintance with the conditions inside the structure through constant reading of his draft gage and the information on the log, he is able to diagnose the ailment. This same applies to the constant formation of air leaks and their detection before they become serious.

This leads to a question we are often asked, "What is the best draft for our furnace"? As far as we know, there can be no set rule. Draft is measured in one-hundredths of inches of water. Until one knows all the characteristics of any boiler as well as conditions of surrounding area and many details, one cannot say what draft to use to get the best results from any boiler, but this only emphasizes the need of draft gages as well as other combustion instruments for only with them can one determine just how that boiler should be handled.

Pump Quiz:

Q: What is the most commonly made mistake in packing stuffing boxes?

A: Forcing in a ring or two of new packing against the old packing, instead of replacing the old completely. Packing should be replaced periodically, using the type recommended by your pump manufacturer.

Q: What do you do if no water is delivered?

A: First, check these possible causes: 1) Lack of prime. 2) Speed too low. 3) Discharge head too high. 4) Suction lift too high. 5) Impeller completely plugged. 6) Wrong direction of rotation. Then, for list of cures, see page 21 of "Handbook for Wartime Care of Centrifugal Pumps".

Q: How tight should a gland be drawn?

A: To control liquid flow, it should be drawn just tight enough so that a thin stream of liquid flows from the stuffing box during pump operation.

Q: Which goes into position first on installation...the pump or the piping?

A: All piping should be in place and self-supporting *before* connection. Openings should meet with no force. Otherwise casing to apt to crack... or spring enough to allow closely fitted pump parts to rub.

Q: How do you determine whether there are air leaks in the stuffing box?

A: Check to see if thin stream of water flows from stuffing box while pump operates. If not — and adjusting gland to reasonable extent does not produce flow — new packing is probably needed. Or — water seal piping may be plugged... lantern ring may be displaced. Pages 21, 22 and 23 of "Handbook for Wartime Care of Centrifugal Pumps" contain tables showing "causes" and "cures" for most common pump ailments.

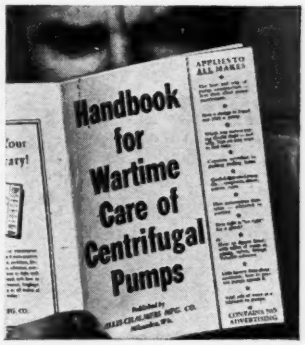
When you do need new pumps — look into the extra efficiency and long life built into Allis-Chalmers centrifugal pumps... all types for every purpose. Meanwhile, every executive, engineer and maintenance man should have a copy of "Handbook for Wartime Care of Centrifugal Pumps" to help make present pumps *last!*

ALLIS-CHALMERS
MILWAUKEE

WE WORK FOR VICTORY — WE PLAN FOR PEACE

DO ALL YOUR MEN KNOW THE ANSWERS TO THESE AND OTHER MAINTENANCE QUESTIONS? IF YOU NOW HAVE A "GREEN HELP" PROBLEM, GET THIS NEW BOOK!

MOST BOOKS on pump care published before the war are *obsolete* today! Why? Pumps that used to work 1800 hours a year now work as many as 8700 hours! For *timely* aid, get your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps"!



Contents include valuable tables of friction losses, a guide to locating trouble, a maintenance timetable geared to wartime! Get *your* copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

Gentlemen:

Yes, I would like to receive, free of charge, a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name) .....

(Title) .....

(Company) .....

(Street Address) .....

(City and State) .....

A 1654-3

Dart Unions

AREN'T dipped in the Fountain of Youth...

...but Your Old Darts WILL Give "Good as New" Performance

There is nothing mythical about a Dart's long life . . . nor in the fact that no matter *how much* service a Dart Union has already given, it can still supply "Tight-joint" performance back on the job.

The *real* reasons that Darts are famous for their extra dividends in life and service are found in the way they are designed . . . and what they are made of. To be specific: Darts have matched bronze seats, ground to "true-ball" surfaces . . . and Dart Nuts and Bodies are made of High Test Air Refined Malleable Iron that resists corrosion, pipe strains and rough handling.

Even though you have already authorized one or *several* searches around your plant for used Darts to put back to work, it will pay you to make *another*. And see your supplier for *new* Darts.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Simple Tests for Rubber Substitutes

SINCE the beginning of the rubber shortage, many samples of proposed substitutes for rubber have been submitted to the National Bureau of Standards for test. Although many different materials have been proposed, a great majority of them fail to meet certain simple tests that have been applied. It seems worthwhile, therefore, to describe tests to determine whether or not a proposed material possesses the basic characteristics of rubber to a sufficient degree to warrant further consideration and laboratory study.

Characteristic Properties of Rubber

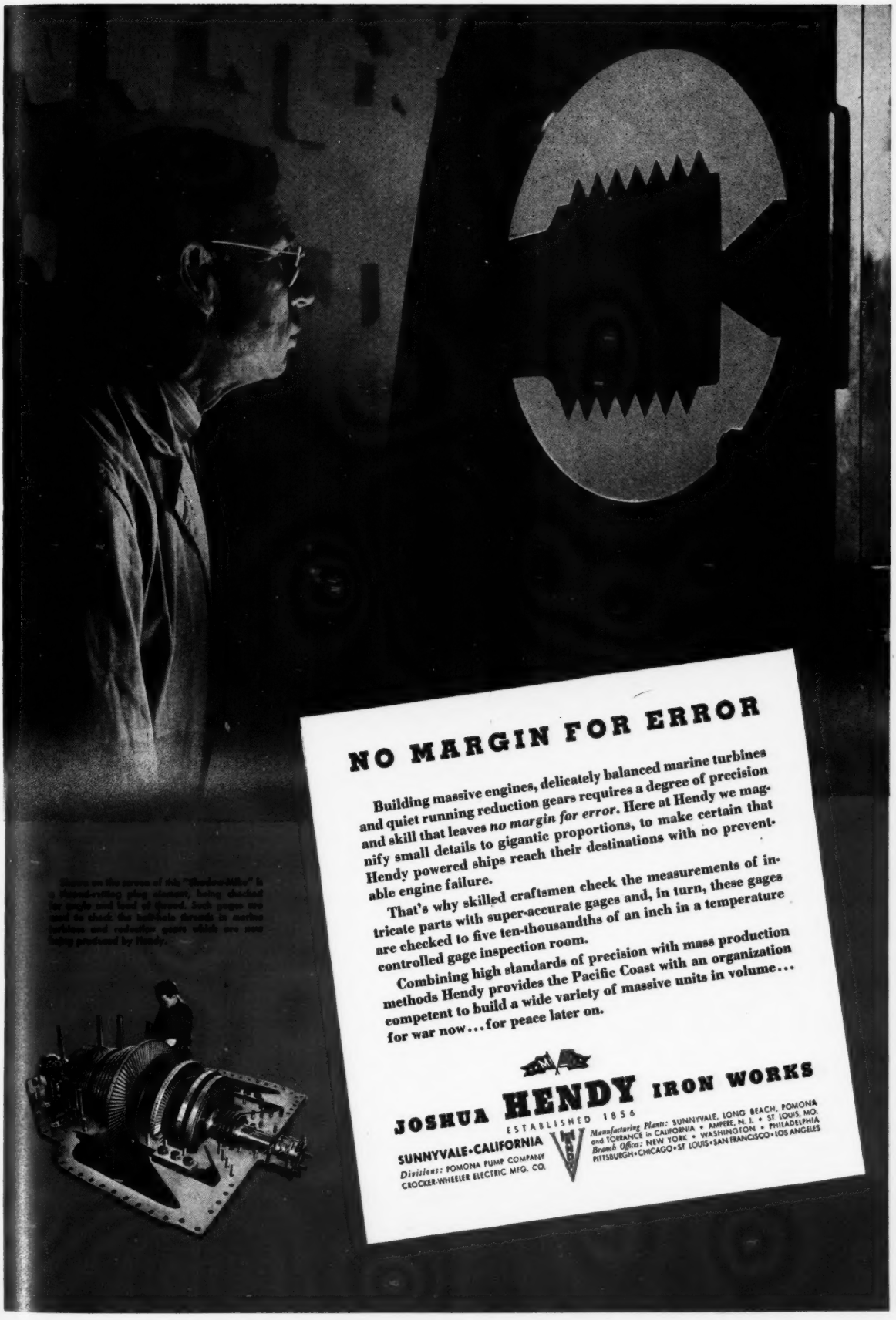
If a material is to serve as a practical substitute for rubber, it should be extensible, resilient, tough, waterproof, resistant to drying, and relatively unaffected by summer heat and winter cold. Simple tests, which anyone can apply, to determine these properties are described by the Bureau as follows:

1. Cut a strip of the material and note how much it can be stretched before it breaks. Observe also whether the broken portions snap back or whether they recover only slowly. If a material will snap back after being stretched to three or four times its original length, it has promise as a substitute for rubber; if it breaks before being stretched this much or if it recovers slowly, its probable usefulness will be correspondingly limited. If it cannot be stretched to at least double its original length, it can scarcely be considered for use in the place of rubber.

2. Try to cut the material with the thumbnail. If it resists cutting, it merits further consideration, but if it can be picked to pieces or if it crumbles when rolled vigorously between the thumb and forefinger, it could be considered only for minor uses, such as erasers.

3. Soak a thin piece of the material in water for a few days and note whether it disintegrates, swells, or becomes weaker than the original material. Although inability to withstand water need not bar a material from further consideration, it should be borne in mind that in most applications of rubber, waterproofness is an important consideration.

4. Keep a thin piece of the material in a warm, dry place for a week and note whether it retains its original extensibility and resili-



NO MARGIN FOR ERROR

Building massive engines, delicately balanced marine turbines and quiet running reduction gears requires a degree of precision and skill that leaves *no margin for error*. Here at Hendy we magnify small details to gigantic proportions, to make certain that Hendy powered ships reach their destinations with no preventable engine failure.

That's why skilled craftsmen check the measurements of intricate parts with super-accurate gages and, in turn, these gages are checked to five ten-thousandths of an inch in a temperature controlled gage inspection room.

Combining high standards of precision with mass production methods Hendy provides the Pacific Coast with an organization competent to build a wide variety of massive units in volume... for war now... for peace later on.

JOSHUA **HENDY** IRON WORKS

ESTABLISHED 1856

SUNNYVALE • CALIFORNIA

Divisions: POMONA PUMP COMPANY
CROCKER-WHEELER ELECTRIC MFG. CO.

Manufacturing Plants: SUNNYVALE, LONG BEACH, POMONA and TORRANCE in CALIFORNIA • AMPERE, N. J. • ST. LOUIS, MO.
Branch Offices: NEW YORK • WASHINGTON • PHILADELPHIA
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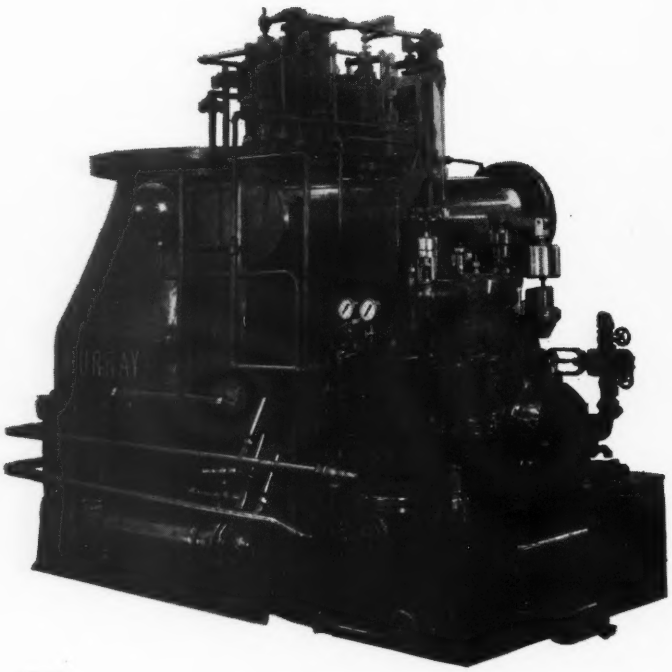
MURRAY TURBINES

For Air Conditioning Compressor Drive



★The requirements of steam turbine drive for air conditioning centrifugal compressors are severe, involving unusual operating conditions ordinarily not encountered in other applications. Murray Turbines have been developed to meet any of these conditions, which include high speeds, critical variable speed governing, necessity for emergency quick shut down in case of abnormalities in the refrigeration system, and frequently, operation from the exhaust of existing reciprocating apparatus.

View shows one of many Murray Turbines designed especially for air conditioning compressor drive. This unit develops 1000 h.p. at 4 lb. initial pressure, 26 in. vacuum and 4100 r.p.m. It is equipped with variable speed, oil pump, oil relay governor; automatic nozzle control; auxiliary turbine driven starting oil pump; vacuum breaker actuated by overspeed governor; solenoid trip to stop turbine in case of abnormalites in the refrigeration system. Governor includes automatic control which maintains even temperature of the system's cooling medium by varying the capacity of the compressor through the speed. Steam inlet is 12 in. and exhaust outlet is 36 in. arranged in an upward direction.

Other Murray Turbines are driving air conditioning compressors at 8000 r.p.m., or have extraction or extraction mixed pressure gear to maintain the proper heat balance in the plant. Write for descriptive bulletin.

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

ence. If it dries out or becomes hard and brittle, it can be of no use as a substitute for rubber.

5. Put some of the material in the freezing compartment of an electric refrigerator for a few hours and note whether it retains its extensibility or whether it becomes hard and brittle. Also put some of the material into boiling water and look for evidences of softening and melting. A material which does not withstand these extremes of temperature could replace rubber in a few applications, but would not be generally useful.

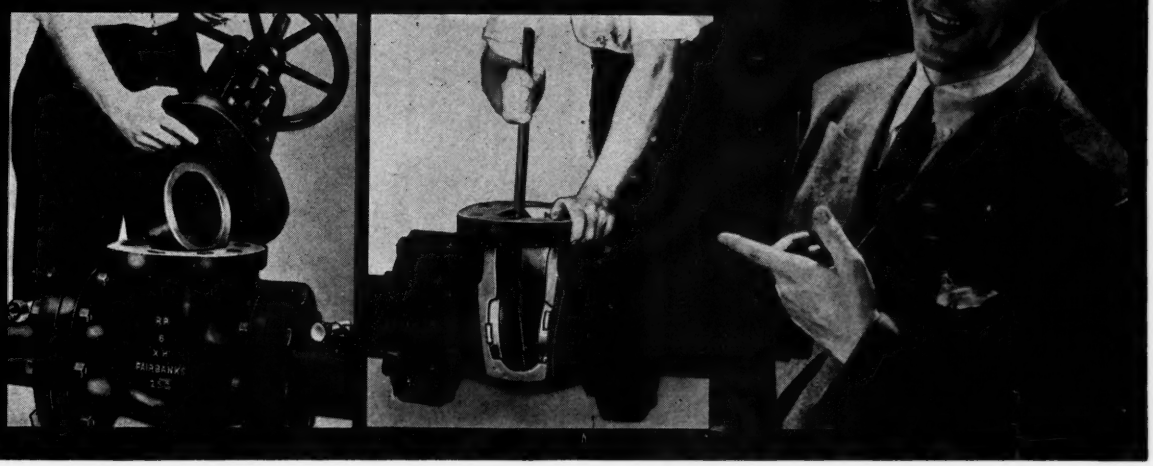
Factice and Gels

A majority of the proposed substitutes submitted to the Bureau represent two types of products which, though well known to industry, apparently have been independently rediscovered by many inventors. These products are *factice*, prepared by the vulcanization of oils; and *gels*, made from glue or gelatine. A brief description of these materials will serve to indicate the respects in which they fail to meet the requirements outlined in the foregoing paragraphs as a general substitute for rubber.

The public seems to be almost entirely unfamiliar with factice, although it is an important industrial material and was known before rubber was introduced in Europe. The rubber-like properties of factice are such that it is often called "rubber substitute" by the trade.

Commercial factice is of two main types. A brown or dark factice is prepared by heating vegetable or fish oils with sulfur. The vegetable oils may include rapeseed, linseed, corn, cottonseed, poppy seed, and castor oils. A white, or light, factice is prepared by the cold vulcanization of an oil with sulfur monochloride; rapeseed or corn oil is favored for the purpose. The principal application of factice is as a compounding ingredient, for which purpose it has been used for nearly 100 yr. It is compatible with synthetic as well as with natural rubber and is employed in combination with them in making insulated wire, druggists' sundries, erasers, stationers' goods, and various other products. The use of factice alone is limited to minor products, such as Artgum erasers, because, in spite of many efforts, it has never been developed with properties which can meet the tests of extensibility and resilience, toughness, and resistance to temperature change shown to be

Look at the WORKS!



Any valve can be handsomely finished. But what really counts are the working parts.

The reputation of Fairbanks Valves for dependable operation, low maintenance cost and remarkably long life, is due to the quality and thoroughness employed in their manufacture.

Fairbanks Valves are the product of experienced valve makers, men who do nothing else and who take pride in their work. At every important step in their manufacture there is constant, earnest, vigilance over materials and every operation. That's why we say "You can Bank on Fairbanks Valves".

Fairbanks Valves are made in bronze and iron for a large range of pressures. Write for Catalog No. 42 and name of our nearest distributor.

Fig. 0312

THE FAIRBANKS COMPANY

393 Lafayette St. — **New York, N. Y.**

Boston, Mass. — **Pittsburgh, Pa.**

Distributors in Principal Cities

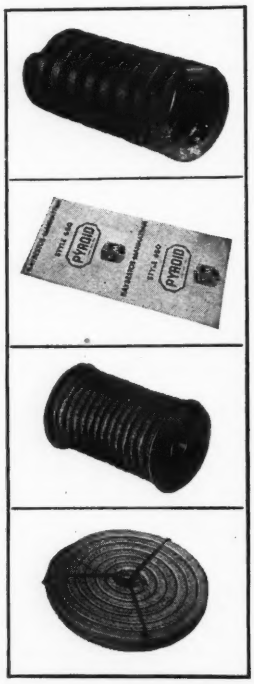
BACK UP THE BOYS AT THE FRONT. BUY WAR BONDS.

Fairbanks *Standard and* Renewable **Valves**

Harvest the fruits of uninterrupted service with sound packing. Eliminate weak spots in steam lines, oil lines, fuel lines, and air lines with R/M Packings. Ceaseless laboratory development over many years has made R/M Packings equal to the added strains of industry at war.

Your local R/M distributor can supply you with the proper R/M Packing material for every industrial use. Ask him for catalog or write us direct.

Awarded to R/M
North Charleston Plant



INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

necessary for a rubber substitute.

Many persons are unaware of the fact that rubber-like compounds made from glue and gelatine have long been known and used in industry. They were extensively employed at one time in making printers' rolls, but were displaced to a large extent by synthetic rubber in the 1930's. With the present rubber shortage, however, they are coming back into use. The compounds from which printers' rolls are made usually contain glue or gelatine, water, glycerine, and a tanning agent. The glycerine keeps the compound from drying out, while the tanning agent stabilizes the compound and keeps it from softening with heat. At best, the gels made from glue and gelatine are so inferior to rubber in extensibility, toughness, and resistance to water that it is doubtful whether they will satisfactorily replace rubber in any but a few special products.

Mass Production Methods Used on Turbines and Gears

STEAM TURBINES and gears of 4000 and 8500 hp capacity are now in mass production. For the dozens of ships, scores of them alike, sliding into the water at a pace that has amazed not only the world, but also Americans themselves, it has been possible to simplify steam turbines and reduction gears to a few styles with many interchangeable parts. Thus war has made it possible to put the steam turbine on a production line in a new plant which has been built to manufacture two sizes of turbines and gears rated 4000 and 8500 hp, according to Westinghouse engineers. Old established production line methods were incorporated in this new plant together with many new schemes particularly adapted for turbine and gear manufacturing.

Since skilled workmen are scarce, the accuracy was built into the machines wherever possible. Arc welding is used to a far greater extent than usual. With the parts held in a special jig, the operator can remain in one convenient position, swinging the work in front of him and doing down-hand welding at all times.

Setting up of large castings or sections often took five times as long as the drilling. Special positioners with motions in both horizontal and vertical planes now serve to support and position the parts for drilling. It is safer because the part is less apt to slip

BETTER VALVES FOR STEAM POWER PLANTS COME OUT OF THE WAR

The valves you held have gone through over two years of relentless pressure on all angles of their production. . . . The valves made have gone to war. They continue to take the most direct route to war. So far, none have become available for routine use. . . . But, mark this down: the demands made upon us by this war of which no sane man wants a part have brought to us a wealth of added "know how and better"—things fried out in the heat of intense production—on specific points of the very valves we will be producing for you as soon as there is relief from the pressure upon us. Better Valves for Steam Power Plants have come out of the war.

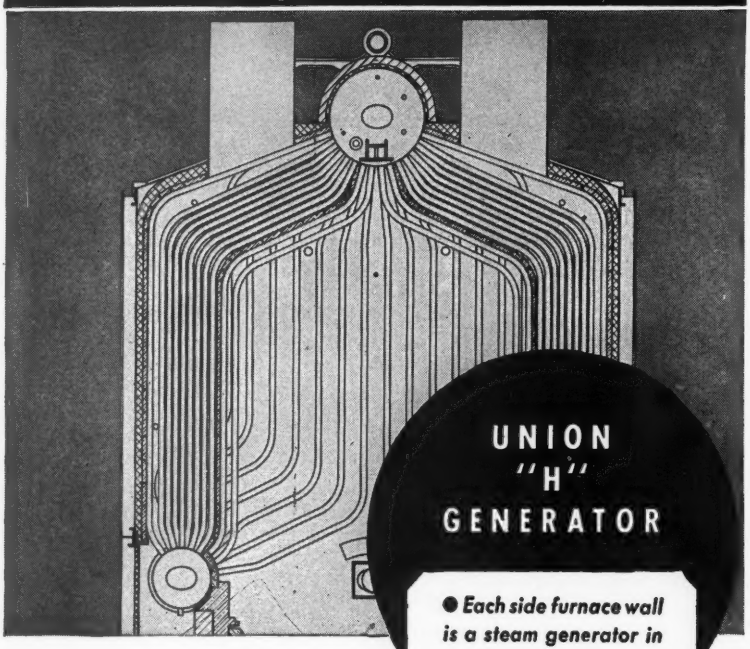
ACCO

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES • D'ESTE VALVE AND ENGINEERING SPECIALTIES
Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles New York, Philadelphia, Pittsburgh, San Francisco, Portland

A DIVISION OF
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT, CONNECTICUT

UNION



UNION "H" GENERATOR

- *Each side furnace wall is a steam generator in itself, yet an integral part of the boiler unit.*
- *Front and rear refractory walls are protected by a water wall with no complicated headers or circulating tubes.*
- *Lower drums are out of the fire.*
- *Upper drum is fully protected from furnace. Write for Bulletin 27 for the complete "H" Generator description.*

THE UNION "H" GENERATOR is an advanced idea in boiler design that provides large and fast steaming capacity in small space. It is, however, only one of many Union water tube and fire tube boilers, each designed to meet a specific set of conditions. A thorough study of your requirements by Union engineers will tell you whether the "H" type or which type of Union Boiler best meets your steam needs. *Write us today.*

UNION IRON WORKS • ERIE, PA.

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

during setting up operations, the drilling is done more accurately and in one third the time.

Instead of adding heavy plates to foundation piece till finished, housings are now built in eight separate assemblies. The sub-assembly method permits the welding to be done on easily handled sizes. Use of the welding turntable makes it possible to do all down-hand welding, and this can be done by women welders.

For boring ten large holes for bearings in many gear cases, two 3-spindle machines were designed and built, each able to bore simultaneously one 35 in. and two 26 in. holes. With the three boring bars of this new mill, all five gear case holes can be drilled in the time previously required to drill only the large bull-gear bore. Because all holes are bored in the 8500 shaft-hp gear case in one set-up, the alignment of the five finished bores is much more accurate than was previously possible.

To avoid building many new large lathes and vertical boring mills, new carbide-steel has been substituted for standard high-speed steel in cutting tools. From about 50 ft a minute, cutting speed has been raised to approximately 220 ft a minute. Thus, a great deal of material, factory space and time have been saved.

Correction of Engine Parts Forestalls Trouble

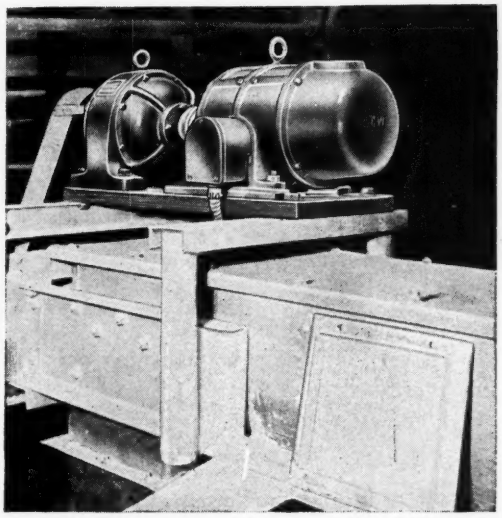
WHEN A STEAM ENGINE has seen considerable service, trouble is liable to occur at the connections in the valve rod and the eccentric rod. If wear occurs to such an extent as to permit play between the two rods, the timing of the valve will be altered.

In one instance, a severe knock was continuously occurring in the high pressure cylinder of a locomobile engine. The cause of this knock was eventually traced to play in this connection which had altered the timing to such an extent that there was practically no cushioning at one end of the cylinder, hence a severe knock occurred as the piston approached the dead centers. After this wear was taken up and the timing was adjusted, the knock disappeared. The best precaution against this wear is to keep these joints well lubricated.

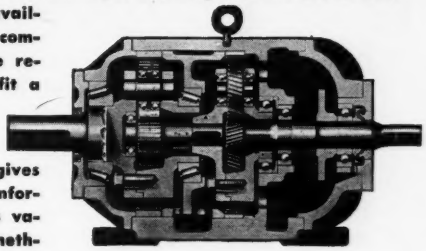
In another case, a uniflow engine broke down through the piston seizing because of faulty cylinder lubrication. The cylinder lubricators were discovered to be out of order and delivering an insufficient

Why IS THE PHILADELPHIA PLANETARY REDUCER THE *RIGHT CHOICE* FOR A STRAIGHT LINE DRIVE?

The principle of the Planetary design was proved efficient, dependable and highly practical by Philadelphia MotoReduceRs. Those complete motor and speed reducer drive units employed the planetary construction. So well have they performed in the past dozen years that a demand was created for the same type of reducer for use where a separate speed reduction unit was indicated. This demand is being met by the Philadelphia Planetary Reducer which embodies the same features, parts and precision manufacture as the MotoReduceR.



Philadelphia Planetary Speed Reducers are compact in design yet rugged in construction. Input and output shafts are in line. These units are available in single, compound and double reduction types to fit a variety of needs.



Our catalog 100 gives more complete information and shows various mounting methods. Write for a copy.

ARMY E NAVY

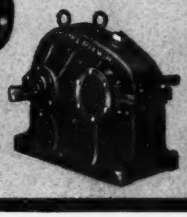
PHILADELPHIA GEAR WORKS, INC.

INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

ERIE AVENUE & G STREET
PHILADELPHIA 34, PENNA.
NEW YORK, PITTSBURGH, CHICAGO

***Philadelphia* LIMITORQUE CONTROL** operates all types of valves, etc., safely, economically, from convenient stations.

***Philadelphia* GEARS** All types and sizes of industrial gears. Can be supplied in all materials.

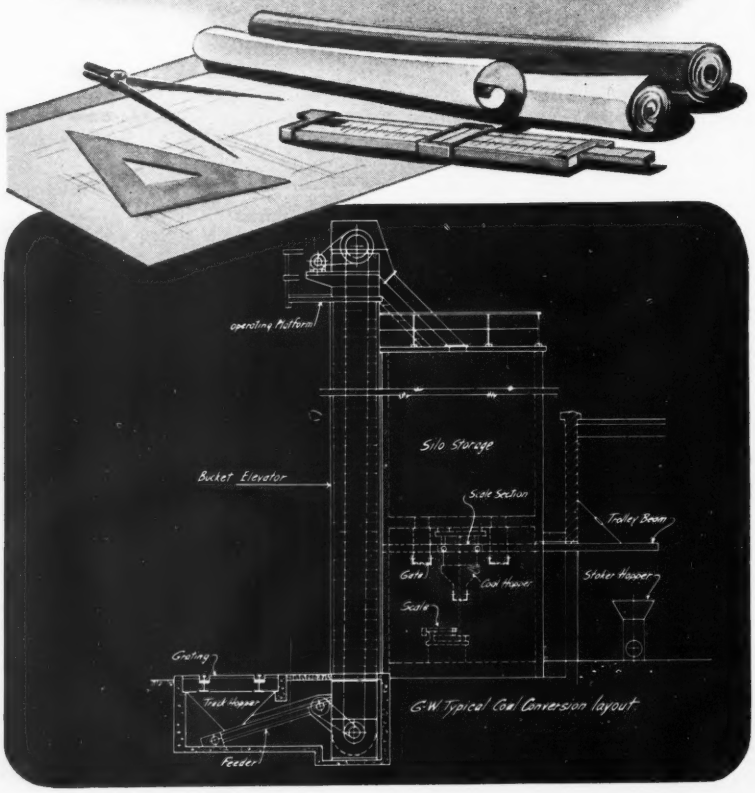


***Philadelphia* HERRINGBONE SPEED REDUCER** for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

***Philadelphia* MOTOREDUCER** The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

***Philadelphia* WORM GEAR SPEED REDUCER** right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

FOR FAST CONVERSION TO COAL... LET G-W HANDLE THE DETAILS



Getting a coal and ash handling system needn't tie up your busy engineers. If they haven't time to design a complete conversion job, Gifford-Wood will submit a dependable standard design, adapt it to your needs, produce and install the equipment promptly. You'll be proof against fuel oil shortage with an efficient, long-lasting, guaranteed installation.

Say the word and G-W will arrange to send you a complete plan and proposal—using your design or ours. Make it easier to choose your equipment with the latest G-W catalog. It's mostly pictures, drawings, tables and engineering data. Write for catalog E200.

GIFFORD-WOOD CO.

FOUNDED 1814

420 Lexington Avenue
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HUDSON, N. Y.

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Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

amount of oil. In addition to this, the original cast iron piston had been replaced by one of steel casting. Steel pistons are unsuitable for use in horizontal engines and this piston aggravated the lubrication trouble.

Efficient lubrication of uniflow engines is important; an oil should be used that is capable of fully standing the cylinder temperature and sufficient lubrication should be used to insure distribution of the lubricant throughout the cylinder. Occasionally the piston rods should be removed from the crossheads for examination, as it is not unusual to find cracks developing around the cotter pin holes.

Cable Coupler Saves Material, Speeds Production

ELIMINATING A BOTTLENECK and paving the way for savings of tons of critical materials, Walter W. Brown, engineer of the General Electric Co.'s transportation department, redesigned the cable couplers for a piece of war equipment in quantity production.

Savings already amount to 8900 lb of brass rod; 21,500 lb of phosphor bronze (which contains 18 to 20 per cent of tin); and 120,000 lb of aluminum—all remarkable quantities considering that only one of the coupler parts redesigned weighed more than a few ounces.

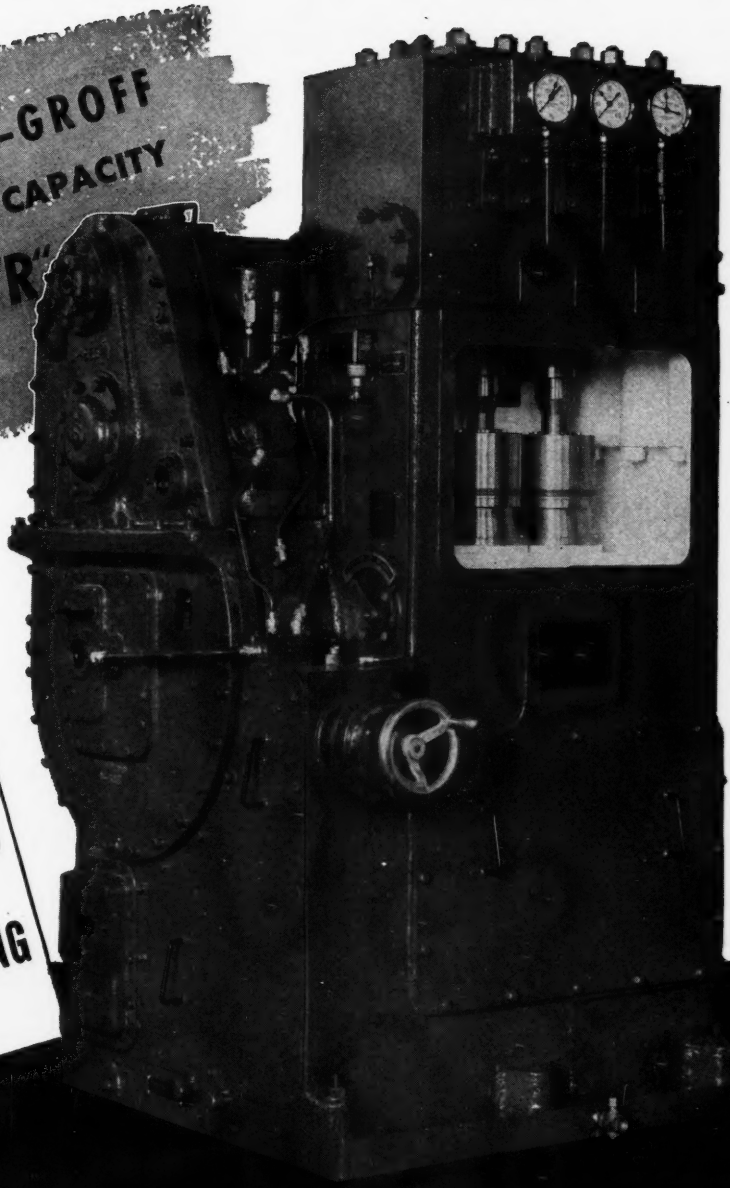
Strict interchangeability of component parts was maintained without changing the type or form of the couplers or any of their catalog numbers. Thus, supply parts ordered from existing catalogs will fit couplers already in the field.

Originally an aluminum die-casting, the coupler bodies are now made from steel tubing and punchings formed to shape. This eliminates the need for machining. Transferring the job to the punch-press department speeded production 50 per cent.

Drawing the tubing to the required shape was the most difficult problem in the design change. Swaging has replaced the machining operations formerly required for almost all parts of the couplers.

Designing improved manufacturing methods is not a new venture for Walter W. Brown. In 1926 he received a Charles A. Coffin Foundation Award for designing an improvement in the method of manufacturing controller parts and controller fingers. Mr. Brown has been with General Electric 33 yr.

THE ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP . . .



. . . for MAIN BOILER FEED and DESUPERHEATING SERVICE

Aldrich-Groff Pumps provide for automatic or remote manual control of delivery, from zero to full capacity, at constant pump speed. Rate of delivery is controlled by varying the length of the plunger stroke, and power consumption is almost directly proportional to pump delivery. These pumps combine the positive displacement and high efficiency of the plunger type pump with the flexibility and smoothness of a centrifugal.

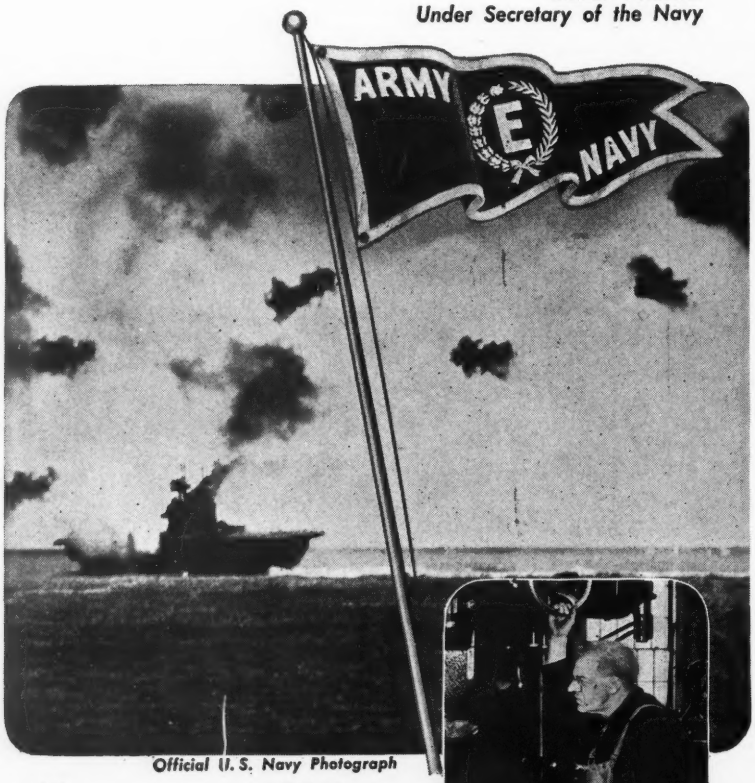
The use of these pumps with unit feed systems eliminates the pressure and power losses associated with throttling-type feed-regulating valves. They provide advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for de-superheater feed service in even the largest power stations. Over 100 units in operation on land and sea with outstanding service records.

Write today for the Aldrich Bulletin 65. It gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" Pumps.

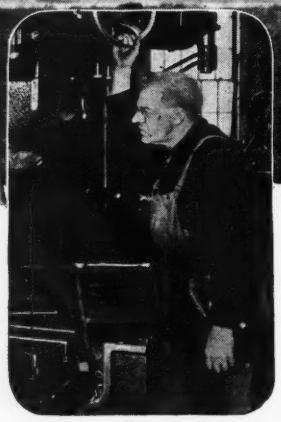
THE ALDRICH PUMP CO. ALLENTOWN, PENNA.

"—you have set up a record which is only to be broken"

—James Forrestal
Under Secretary of the Navy



Official U. S. Navy Photograph



You are talking our language, Mr. Forrestal!

We acknowledge the honor and privilege of flying the Army-Navy "E" flag. We acknowledge, too, that this recognition comes to us for work already done. We fully realize the increasing need for Warren Pumps to meet the schedules of our Navy's building program. Therefore, we accept your challenge, Mr. Forrestal, that we have set up a record and we are determined to surpass it!

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

WARREN

Equipment Suppliers Inspect New J. I. Case Boiler

J. I. Case Co., Racine, Wis., manufacturer of tractors and other farm machinery, held a reception and inspection trip at its plant on September 9, 1943, for representatives of all the manufacturers of power plant equipment who supplied their products for incorporation in its new boiler installation. The new steam generating unit recently installed in the company's existing power plant has a designed continuous capacity of 75,000 lb of steam an hour at 450 psi, 750 F. It is operated at present at 500 F.

Boiler and water walls were supplied by Murray Iron Works, superheater and economizer and air heater by Foster Wheeler Corp., forced and induced draft fans by Buffalo Forge Co., continuous cleaning spreader type stoker by Detroit Stoker Co., furnace walls by Bigelow Liptak Corp., combustion controls and meters by Bailey Meter Co., ash conveyor by United Conveyor Corp., setting insulation by A. P. Green Co. and soot blowers by Vulcan Soot Blower Co.

The engineering and sales representatives of the foregoing companies, together with other visiting engineers, inspected the new steam generating unit in the morning, and were guests at a dinner at the Racine Country Club in the evening. The following men were guests:

K. H. Bedell, Foster Wheeler Corporation
E. L. Beckwith, Detroit Stoker Company
Arno Dietze, Vulcan Soot Blower Company
Jack Dorner, United Conveyor Company
L. D. Emmert, Buffalo Forge Company
Geo. H. Fredericks, Geo. H. Fredricks Company
F. W. Herzog, Sprinkman & Sons
W. H. Hoff, Murray Iron Works
H. M. Jones, Murray Iron Works
R. V. Knapp, Bailey Meter Company
H. S. McCotter, Detroit Stoker Company
Fred Orser, Orser Construction Company
Thatcher Rea, Detroit Stoker Company
J. M. Whiteside, Bigelow Liptak Corporation

SAVES TIME
FOR THE PIPING DESIGNER

Revised and Enlarged Edition

Simple and Easy to Use

Simplified Method for
CALCULATION OF PIPE WALL THICKNESS
for Various Pressures and Temperatures based on
A.S.T.M. and A.P.I. Specifications and the A.S.A. Code for Pressure Piping

BULLETIN 43-A
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Originated and Developed by Engineering Department
MIDWEST PIPING & SUPPLY CO., INC.
St. Louis 4, Mo., U.S.A.

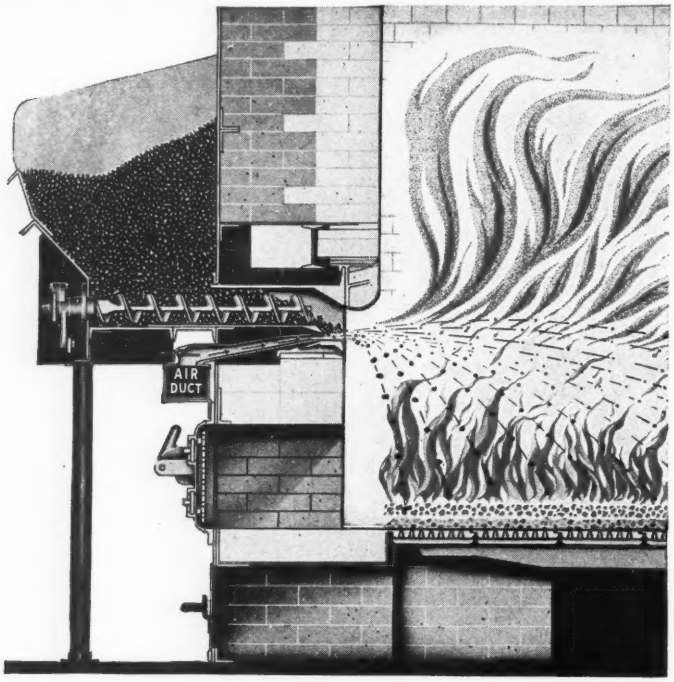
This bulletin will enable you to determine quickly and easily the required pipe wall thicknesses for commercial pressure and temperature conditions. All you do is select a factor from a table, divide it into the working pressure and then refer the quotient to a chart. You have no substitution in formulae . . . no extensive calculations . . . no reference to codes or specifications.

This bulletin will gladly be sent to anyone interested who requests it upon a business letterhead. Simply mention Bulletin 43-A and address the main office at St. Louis, Missouri.

MIDWEST PIPING & SUPPLY CO., INC.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles
Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

PIPING FABRICATORS AND MANUFACTURERS OF PIPE WELDING FITTINGS

Need more steam *Capacity?*



USE FYR-FEEDER MULTIPLE-SPREADER STOKERS

Good news for plants with overloaded boilers: Priorities are being granted for FYR-FEEDER stokers to plants requiring additional steam generating capacity. **QUICK DELIVERY:** *We can make quick delivery on Fyr-Feeder stokers, which can be installed with a minimum loss of production time, and without major alteration to present boiler equipment.*

FYR-FEEDER STOKERS burn any kind and size of bituminous screenings or coal yard sweepings. FYR-FEEDER features: Suitable for large or small boilers . . . low maintenance . . . low power requirements . . . maximum active coal burning area (no dead plates) . . . easily accessible multiple feeding units . . . large coal hopper capacity . . . accurate over-fire air control . . . no clinkers . . . can be operated by anybody.

WRITE FOR CATALOG *and have an engineer make a survey of your plant, without obligation, to show you what FYR-FEEDER can do.*

AMERICAN COAL BURNER COMPANY
ENGINEERS • ESTABLISHED 1918
Builders of thousands of Industrial Stokers

22-18 E. Erie St. **Chicago, Illinois**

Insulation Coordination Protects Power Systems

FAR-REACHING STEPS taken in the last decade toward insuring an uninterrupted flow of electric power to the nation's war-busy industrial plants were described recently to members of the Chicago chapter of the American Institute of Electrical Engineers. The success which has been achieved in protecting our power systems against unexpected electrical disturbances has been largely the result of a program of insulation coordination, according to H. N. Muller, an engineer with the Westinghouse Electric & Mfg. Co. Insulation coordination means the arrangement of a power station's protective system so that lightning strokes or other unexpected electrical surges are shunted off to ground before they can flash over and damage vital equipment. The day is past when the protection of a power system against such disturbances is left to chance, Mr. Muller pointed out. Today, transformers and generators containing thousands of tons of critical copper and steel can be made practically immune to serious lightning damage; this is done through installation of protective equipment for draining off the lightning and surge voltages at successive levels.

Ten years of study have gone into this problem. At one time protective devices were installed at random on power systems with no real assurance that they would protect the system against lightning or other electrical surges. It is largely a matter of good fortune, Mr. Muller pointed out, that many big transformers and generators are still operating after 20 yr of service. Through cooperative efforts of public utilities and electrical manufacturers, insulation standardization has been achieved. Laboratory test procedure was made uniform; thus lightning strength of various types of insulators has been standardized and all laboratories have accepted these values.

Mr. Muller illustrated how insulation coordination works by citing a typical problem. A utility system contemplates building a new 138,000-v power station. Standardized tables, now available, show that a power station of this class requires protection against lightning or other electrical surges of at least 650,000 v. This figure —known as the basic insulation level—provides a safe and sound

WeldELLS *have everything* ★

"It's my job to find better ways—"

"A plant superintendent's tough job, as I see it, is to size up the facts and separate the something better from the so-called good enough. After all, there is only one *best* way to do a thing and it's my assignment to find it.

"Of course the difference between best and next best isn't so very great in some cases. But when it comes to welding fittings I think a cold appraisal will give a distinct edge to WeldELLS.*

"WeldELLS are basically sound from the start: Seamless—reinforced where stresses are greatest—engineered down to the last detail. Then, over on the practical side, they have everything it takes to speed up the job and cut costs. The clean machine tool bevels facilitate good welding and cut piping costs. Precision quarter-marks are a big help to the welder; and the permanent markings of size and weight on every WeldELL are nothing short of a must."

Yes, whether you are looking for safety, utility, convenience or economy—and who doesn't want them all?—you have in WeldELLS one of those rare products that offers you EVERYTHING!

★ **WeldELLS alone have all these features:**

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

TAYLOR FORGE & PIPE WORKS
General Offices & Works:
Chicago, P. O. Box 485
New York Office: 50 Church Street
Philadelphia Office: Broad St. Station Bldg.

*WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

Silent SERVANTS to your BOILERS

HENSZEY
BOILER FEED REGULATORS

control boiler water levels continuously and accurately under all load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary—nothing to get out of order—nothing to rust.

Made for pressures up to 600 lbs. and in sizes up to 4 inches.

Send for latest Bulletin containing full details.

HENSZEY COMPANY, Dept. C10—Watertown, Wis.

HENSZEY
BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

basis on which to purchase all the various types of equipment for the power station. Thus, each piece of equipment, including insulators and protective devices, is selected for its ability to withstand electrical surges of this basic intensity. The net result is insulation coordination and virtual immunity of the power station to serious damage from lightning or other electrical disturbances.

One Thousandth Condenser for Liberty Ships

EARLY IN THE Liberty Ship program, the Jersey City shops of The M. W. Kellogg Co. were designated by the U. S. Maritime Commission to build main condensers for the Liberty Ships. Since then, the Jersey City plant has worked continuously to produce these main condensers to meet the schedules of the Maritime Commission. This schedule has involved shipment of as many as one hundred condensers in one month, shipments being made to many points in the United States.

Shipment of the one thousandth main condenser took place during the last week in August.

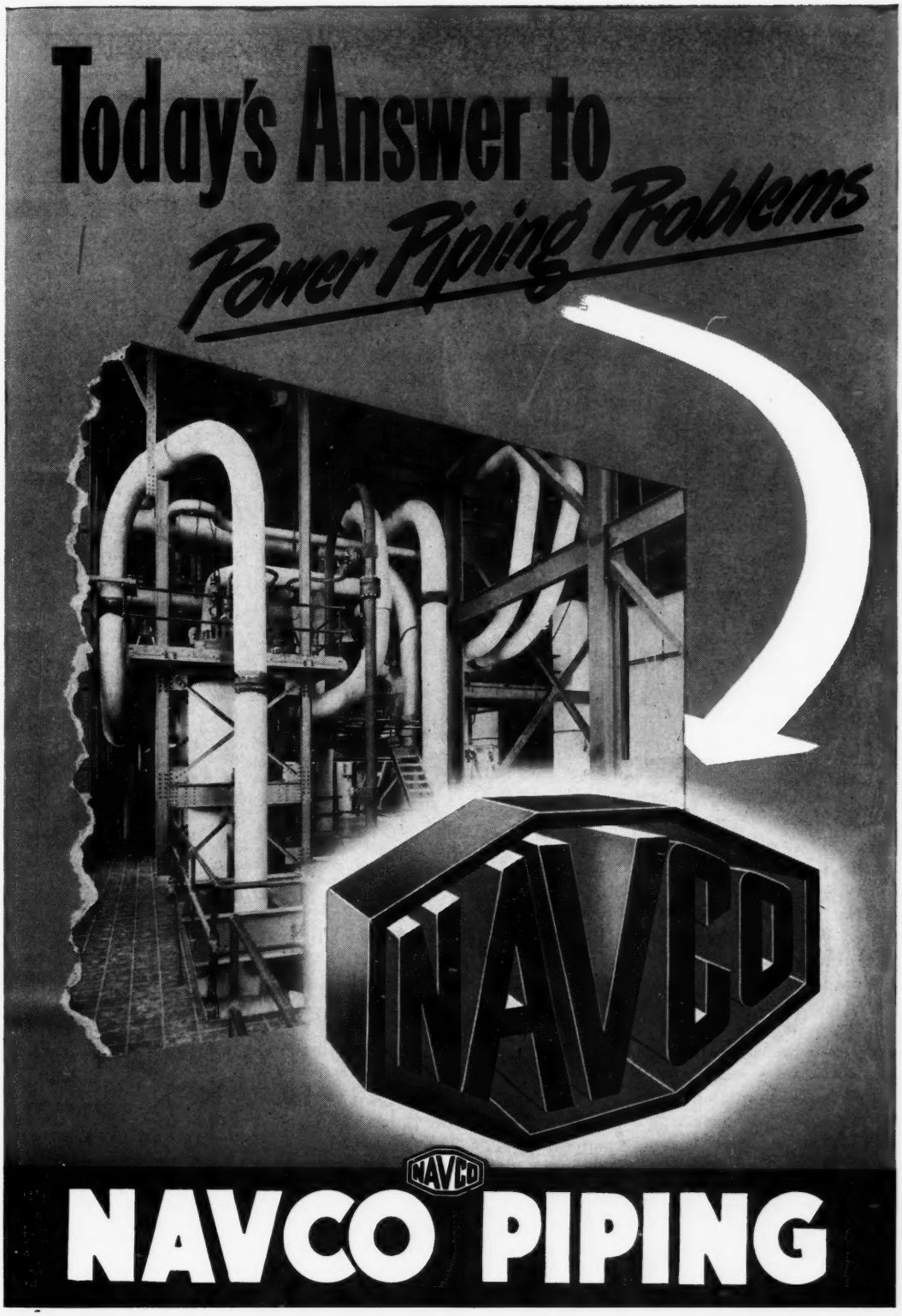
Recognition for outstanding production achievement by the M. W. Kellogg Co. and its employees was made by the United States Maritime Commission on August 3, 1943, with the award of the "Gold Star."

To Investigate Bearings Requirements

A GROUP of consultants drawn from the anti-friction bearings industry has been formed by the War Production Board to resurvey essential wartime requirements for bearings and to study the volume of individual purchase orders in relation to these requirements. These WPB consultants are a part of the Anti-Friction Bearing Section of the Tools Division, War Production Board.

They will meet at frequent intervals to discuss and advise on problems in the supply of anti-friction bearings and to investigate and take action to correct any instances of over-purchasing or excess inventories. The production and distribution of anti-friction bearings is covered by General Preference Order E-10. The order defines an anti-friction bearing as any bearing employing as rolling elements, balls of any size or rollers of any size or shape.

Today's Answer to *Power Piping Problems*

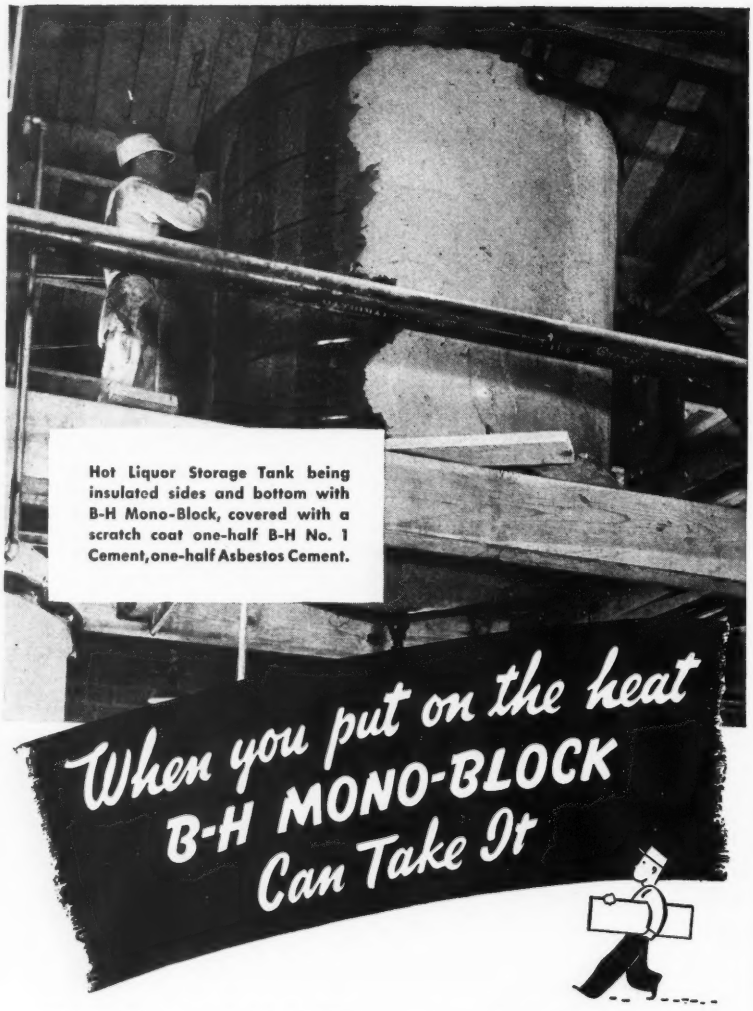


NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING CO.

PITTSBURGH **PENNSYLVANIA**



Hot Liquor Storage Tank being insulated sides and bottom with B-H Mono-Block, covered with a scratch coat one-half B-H No. 1 Cement, one-half Asbestos Cement.

You can't beat Baldwin-Hill Mono-Block Insulation for performance when it comes to boilers, engines, ovens, furnaces, and other high-temperature installations. Here is a felted block insulation that is effective over the entire temperature range up to 1700° F. in contrast with most other molded type insulation blocks that are made for either high or normal temperatures —not both.

B-H Mono-Block is felted by a patented process from *black* rock-wool that refuses to break down under much greater heat than many other types of insulation can stand. It is moisture-resistant and will not disintegrate under humid conditions. Being exceptionally low in conductivity, it does a better job of saving steam costs.

B-H Mono-Block is easy to install. It is sufficiently rigid to support its own weight, and yet yielding enough to absorb surface irregularities. Send for full information and generous sample.

BALDWIN-HILL BH INSULATIONS

BALDWIN-HILL COMPANY

577 KLAGG AVE. • TRENTON 2, N. J.

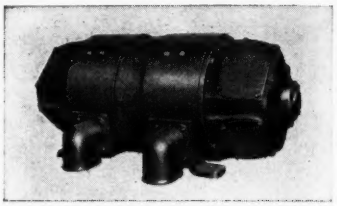
NEW YORK, N. Y. • CHICAGO, ILL. • HUNTINGTON, IND. • KALAMAZOO, MICH.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Two-bearing Motor-Alternator Sets

A NEW LINE of two-bearing (ball), 3600-rpm motor-alternator sets in integral rating up to 5 kva, single-phase, has been announced by the Motor Division of the General Electric Company. Compact and light in weight, these alternator sets are designed for converting direct current to alternating current for various applications. In general, these include any applications which require a-c power, such as radio and other electronic equipment of standard a-c design.



In operation, the d-c motor of the set drives alternator, which has a field connected in series with the motor armature. An increase in the alternator load causes an increase in the motor load, so that increased d-c is drawn from the line. This greater d-c current strengthens the alternator series field, tending to maintain a constant a-c voltage.

The motor and the alternator of these sets are similar in that the armature windings are on the rotating elements and the fields are stationary, being attached to the frames. A solid shaft, supported by a ball bearing at each end, serves to mount the rotating members of both the motor and the alternator, thus eliminating a number of parts and making for a considerable saving in weight. The sets are very easy to disassemble—the complete rotating unit may be pulled out of the stator merely by removing an end shield.

Hard Hat

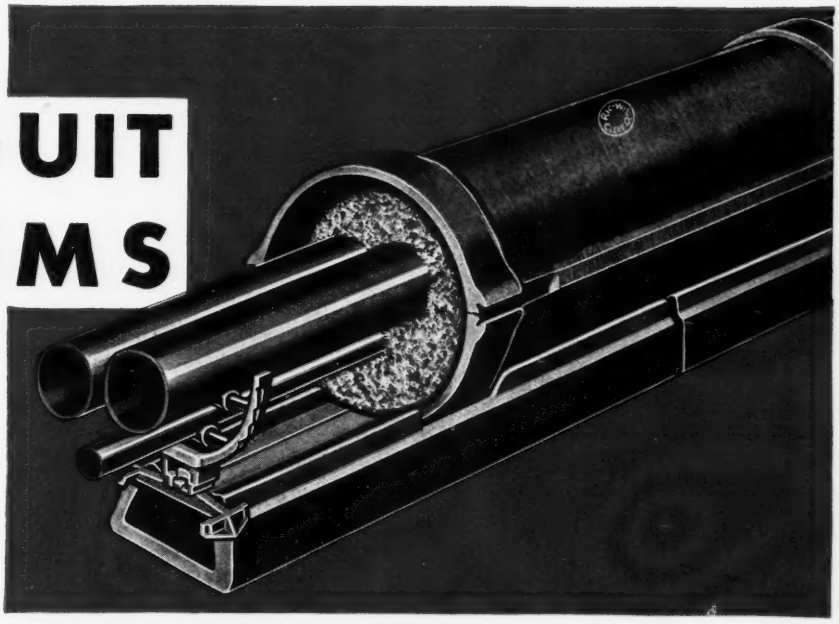
THE DAVIS EMERGENCY EQUIPMENT Co., Halleck Street, Newark 4, N. J., has perfected a new hard hat offered to industry under the trade name Hedgard. Hedgard is built to give 3-way protection to its wearer. Yet the weight has been kept at a minimum. The top of the crown of Davis Hedgard is reinforced for direct blows. The side of the crown is built to stand glancing blows and the brim is made flexible yet strong so that it will not crack when dropped.

A new moulding process and compounding process makes the hat shatter proof. There is no chance that part of the crown will protrude into the head. The material is not brittle and cannot shatter.

The blow is first absorbed on the crown which has a "give and deflect action." It is further absorbed in the new cradle and sweatband construction

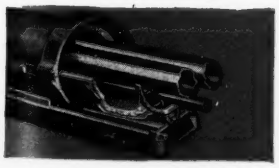
TILE CONDUIT SYSTEMS

FOR UNDERGROUND STEAM LINES



Ric-wiL, pioneer in the tile conduit field, has served the country's needs on underground steam protection with outstanding leadership since 1910. Today, with material supply, production facilities, and plant personnel subjected to severe pressure, it is a point of pride with us that traditional standards of quality are being scrupulously maintained. In spite of heavy demands, we are well equipped to make quick deliveries on all sizes and types of Ric-wiL Tile Conduit, as well as on our complete line of Prefabricated Insulated Pipe Units . . . Conduit illustrated is Ric-wiL Standard Tile with filler insulation. Heavy duty Super-Tile and Cast Iron are also available for this type, and all are adaptable to single or multiple pipe systems.

RIC-WIL TILE CONDUIT FOR OIL OR PROCESS LIQUIDS



In this system, conduit is insulated from the exterior, but individual lines are not insulated from one another. A steam or hot water line can thus maintain temperature to keep liquids flowing in the other lines. Insulation is a diatomaceous earth lining, moulded and keyed to inside circumference of tile. May also be used with fibre insulation for steam heat, power and superheated steam. Applicable to Super-Tile and Cast Iron.

RIC-WIL PREFABRICATED INSULATED PIPE CONDUIT

Completely factory-prefabricated units including pipe and insulation as specified are furnished in convenient 21 foot lengths for speedy installation. Conduit is helical corrugated, coated with asphalt and wrapped with asphalt-saturated asbestos felt. This system is also available for oil or process liquids, and is adaptable to overhead as well as underground installations.

Many other types of Ric-wiL conduit are available to meet individual requirements. Write for complete information.

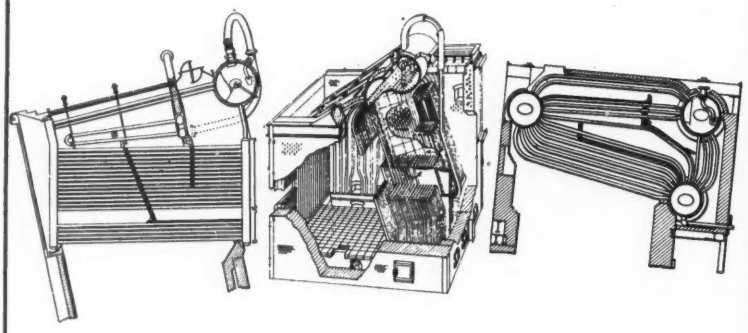
RIC-WIL INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

which acts as a shock absorber. The hat will stand better than 8 lb dropped 10 ft which is twice the standard drop-test. Yet with all this strength the hat weighs slightly more than 13 oz, depending upon the type of sweatband used.

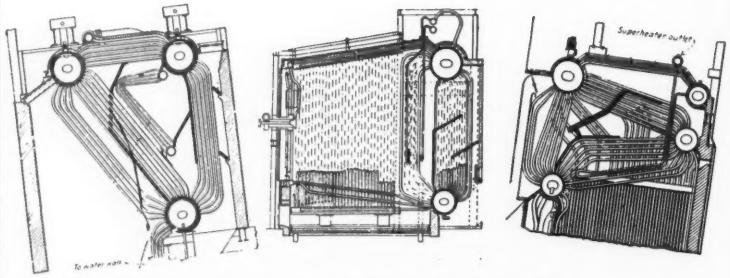
Pulsation Dampener

THE ASHCROFT GAUGE DIVISION of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., announces its new Type 1106 Ashcroft Pulsation Dampener, a small, compact and effective throttling device which is said to be ideal for use with pressure gauges subject to severe pressure pulsations and rapid fluctuations, such as on reciprocating pumps. It is good for all pressures up to 5000 psi and for any pressure medium, such as air, water, oil, or steam.

The operation of the dampener is simple. A small monel plunger oscillates freely in a cylindrical hole in the bushing. The clearance between the plunger and hole is just sufficient to give the proper throttling action for certain conditions. The free movement of the plunger makes the device self-cleaning. Five different size holes are provided in the bushing. The plunger may easily be transferred from one hole to another, depending upon the degree of dampening required. All holes are sealed off except the one in use by means of the sealing disc. Number 1 hole, having the smallest diameter, and the least clearance between the plunger and hole, has the most throttling effect.



THERE'S A WILSON TUBE CLEANER FOR EVERY TYPE BOILER



Send for a Copy of our 40-page Catalog

BACK THE ATTACK! BUY WAR BONDS AND STAMPS!

THOMAS C. WILSON, Inc.

PIPE AND TUBE CLEANERS EXCLUSIVELY

THE WILSON BUILDING

21-11 44TH AVE. LONG ISLAND CITY, N. Y.

Industrial Thermometer

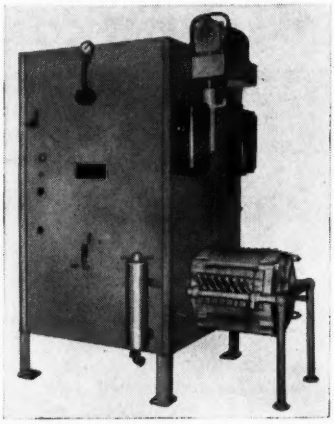
A NEW INDUSTRIAL thermometer with a plastic case front, yellow back, easy reading thermometer tubing and malleable iron back has recently been announced by the C. J. Tagliabue Mfg. Co. of Brooklyn, New York.

Weight is reduced by using a plastic case front and an adequate substitute for metal is provided. The yellow back lens front thermometer tubing is reported to be an improvement over the white back type, since the yellow background offers the best color contrast with the mercury.

Malleable iron has been found to be an entirely satisfactory substitute metal for the brass formerly used, and is fully protected against corrosion by a durable black finish.

Oil Purifier

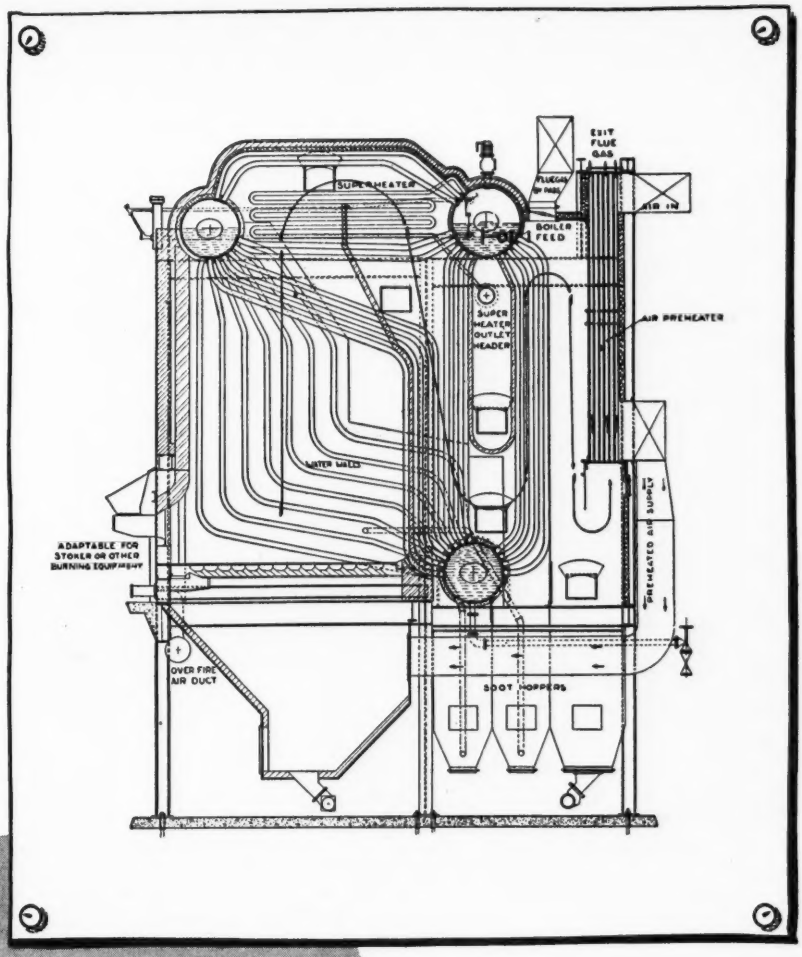
THE HILLIARD CORP., Elmira, N. Y., announces the addition of new units to the line of Hilco Airline Oil Purifiers. These oil purifiers find wide application in the purification of many types of oil, such as used in automobiles, trucks, tractors, Diesel engines, gasoline engines,



steam turbines, Diesel locomotives, vacuum pumps, gas engines, hydraulic presses, air compressors, insulating oils, and many other industrial oils.

Operation consists of drawing the batch of oil to be purified into the heater tank, into which is also introduced Hilite, a highly efficient grade of fullers earth, or activated clay. This entire mixture is thoroughly agitated and heated for

By replacing old equipment with two of these EDGE MOOR Radiant Heat Boilers, one power plant operator found that fuel savings will pay all costs of the new installation in two years' time.



THIS Edge Moor RADIANT HEAT BOILER...

...has INTEGRAL WATER WALLS!

In this EDGE MOOR three drum Radiant Heat Boiler a bank of specially formed tubes at each end of the front drum is connected to the lower drum so as to form water walls on both sides of the furnace. This construction is economical and actually provides water wall operating economy at little increase in boiler cost. The design pioneered by EDGE MOOR eliminates expensive water wall headers, circulating tubes, downcomers and attendant parts which not only add to the investment but complicate the maintenance. Quick steaming, high ratings, side wall protection, moderate height, adaptability to any fuel are definite worthwhile features.

The list of EDGE MOOR installations is rapidly expanding and investigation is invited. Write for catalog 102.

EDGE MOOR IRON WORKS, INC.

EDGE MOOR, DELAWARE

STEAM GENERATING EQUIPMENT

SALES OFFICES: NEW YORK, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO, ILL.: ONE NORTH LA SALLE STREET

MARTINDALE COMMUTATOR
GRINDING AND TURNING TOOLS

The Grinders can be mounted on round stud supports or flat brush arms for turning or grinding while the armature is in position. On large machines turning can often be done without the use of an auxiliary motor by just allowing the machine to coast, starting to turn the commutator when the speed has dropped to a safe value and repeating the operation until the work is completed. In grinding with Martindale Commstones, there is a tremendous saving in time and money due to the fact that motors do not have to be dismantled or slowed down—grinding is done while the commutator is running at full speed, and while all bars are in their true operating position. A Grinding Tool will also correct any eccentricity.

WRITE FOR NO. 24 CATALOG

The man in the illustration above is wearing a Martindale Protective Mask which weighs 2/5 of one ounce. A plastic stamping holds a nonabsorbent cotton filter which completely covers the nose and mouth. The Masks are recommended for artificial abrasives, synthetic enamels, coal dust, etc. They are not recommended for toxic or other injurious dusts. Write for Mask Bulletin or No. 24 Catalog.

THE MARTINDALE ELECTRIC CO.
1432 HIRD AVE. CLEVELAND, OHIO

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

driving off all moisture. The Hilite acts to absorb all solids, such as carbon, tarry matter, abrasives and acids. After heating, the mixture is dropped into a run-down tank, and then by means of compressed air, the mixture is forced into a filter press, where all solids are retained. Then the oil again passes through a secondary filter press, which doubly assures the removal of all solids. The unit shown has a capacity of 50 to 65 gal per batch per hour. Units are available in capacities of 75 to 130 gal per batch per hour, and special units of larger capacity are also available.

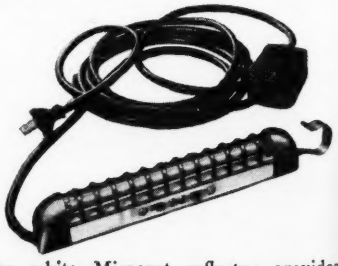
Panel Instruments

A NEW LINE of small, thin, d-c panel instruments featuring a revolutionary internal-pivot construction is announced by the General Electric Co., Schenectady, N. Y., for use in aircraft, radio and communications equipment, and for use on various types of machinery. The line consists of d-c voltmeters, ammeters, milliammeters, microammeters, radio-frequency ammeters, and milliammeters, and d-c volt-ammeters, all available with either brass or molded Textolite dust-proof and moisture-resisting cases in 2½ in. sizes. The volt-ammeter, one of the group designed for naval aircraft, has a push-button-operated switch to change the reading from amperes to volts.

In the new instruments, the pivots are solidly mounted on the inside of the armature shell instead of being secured to the outside of the armature winding in the conventional manner. One jewel bearing is mounted rigidly on top of the core-and-frame assembly and the other is mounted in an adjustable sleeve fitted into the lower part of the soft-iron core, thus making the element assembly a single-self-contained unit, all parts of which are supported by a high-coercive cast magnet, and easily removed for inspection or repair in the field. This design makes the instruments sturdy and renders them excellent for applications where vibration is present. The instruments will operate satisfactorily in temperatures ranging from —50 C to 70 C, and are said to be accurate within the limits of plus or minus 2 per cent of full-scale value.

Fluorescent Extension Cord Unit

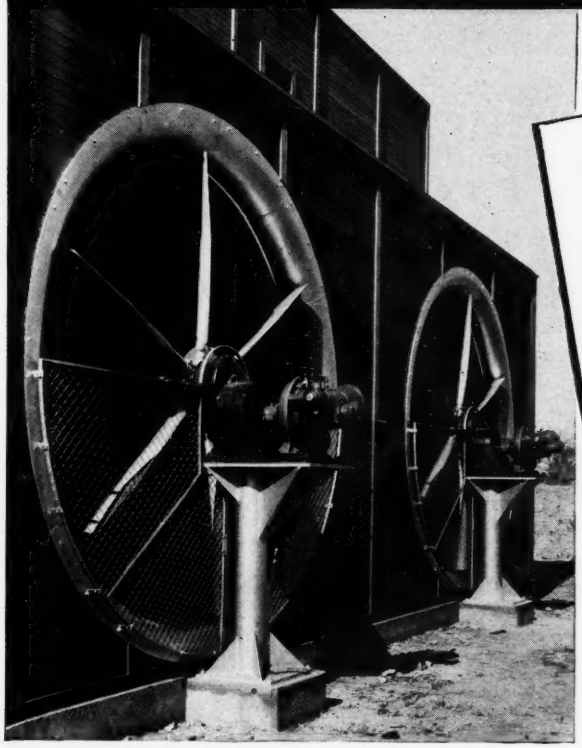
SYLVANIA ELECTRIC PRODUCTS, INC., Ipswich, Mass., announces that its P-7 fluorescent extension cord unit has been streamlined to permit lightning fast lamp changes. Ends have been rounded; rigid hanging hook is riveted to the end cap;



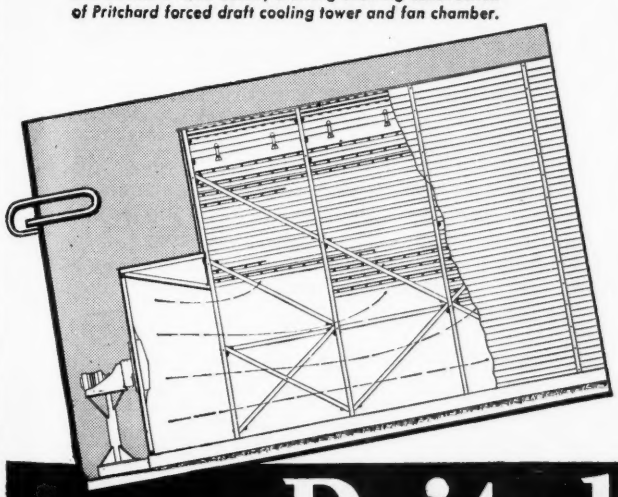
the white Miracoat reflector provides maximum efficiency light output while the rugged French gray grill of the lamp guard and end cap assures a good serviceable finish to withstand the rough service to which the unit is ideally adapted.

The P-7 utilizes the small 6-watt fluorescent lamp which provides an adequate amount of cool, glare-free illumination in

LOW COST COOLING
FOR A LONGER PERIOD OF TIME



View of fan chamber housing two Pritchard light weight non-corrosive fans. Below, drawing showing construction of Pritchard forced draft cooling tower and fan chamber.



Pritchard
COOLING TOWERS
- **Cost Less to Operate**
- **Increase Cooling Efficiency**
- **Prolong Service Life**

SPREAD your cooling costs over a period of five years and you will readily see how PRITCHARD TOWERS give you *low cost cooling.*

Low pumping heads, large pipes and low pressure sprinklers keep power costs down. Counter flow design provides cool dry air to contact coldest water, thus producing lowest possible temperature and increasing cooling efficiency.

Non-corrosive, light weight, wide blade fans move up to 400,000 cubic feet per minute using less power, which further reduces operating costs. Being non-corrosive, fan blades will not pit, thus cost less to maintain and give greater efficiency.

PRITCHARD TOWERS are designed with that extra margin of structural safety that not only withstands ordinary load stresses, but prolongs service life.

Delivery of PRITCHARD COOLING TOWERS is facilitated through standardized sectional construction. A complete line of stock is maintained at all times, ready for immediate shipment.

J. F. Pritchard and Company, *Cooling Tower Division,* Fidelity Building, Kansas City, Mo.

KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

THE ALLPAX CO., INC.
Mamaroneck, N. Y.
•
Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

tight, hard-to-get-at places and the characteristic cool operation of the fluorescent lamp eliminates the discomfort which may be met when a hot incandescent light source is used. The reflector shields the light source from the user and eliminates the danger of eye fatigue. A protecting grill prevents lamp and socket breakage.

The unit operates on 110-125 v, 60 cycle, a-c only. Total wattage including lamps and auxiliary, 8 w. Overall length of the unit is 10½ in., width 1⅞ in., height 1⅞ in. Average weight, 2½ lb, including ballast.

Ampac Welder

THE NEW AMPAC "400" welder, said to be ideal for the average industrial welding shop's wartime needs, has been introduced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This new unit is exceptionally sturdy, self-cooled, and will handle ¼ in. electrodes on the basis of 24-hours-a-day continuous operation, and ample capacity is provided for rods up to ⅜ in. size when needed. It is also adaptable for automatic welding. A range of 50 to 500 amp is covered by the Ampac "400," with power factor correction available if desired.

Outstanding features of the new unit are said to be its low idling loss, high power factor, and extremely high efficiency and excellent welding characteristics over entire range, only eight turns of the control handle being required to cover its entire range. Temperature rise and voltage breakdown tests exceed all NEMA requirements.

Oil and Grease Absorbent

ABSORBO, a new oil and grease absorbent and floor cleaner, has been developed by the Fidelity Chemical Products Corp., 430 Riverside Ave., Newark, N. J. It is listed by the Underwriters' Laboratories, Inc., as a Class 1 noncombustible absorbent for reducing fire and slipping hazards and for cleaning floors.

Absorbo is granular in form but is non-abrasive and will not damage machinery or working parts due to abrasive action. It is said to be odorless, nonpoisonous, and non-injurious to skin, clothing, or flooring. It is readily spread by hand and can be used on any type of floor surface. It is claimed that it will absorb up to 45 to 50 per cent of oil or grease by weight.

Multiple Contact Plugs And Sockets

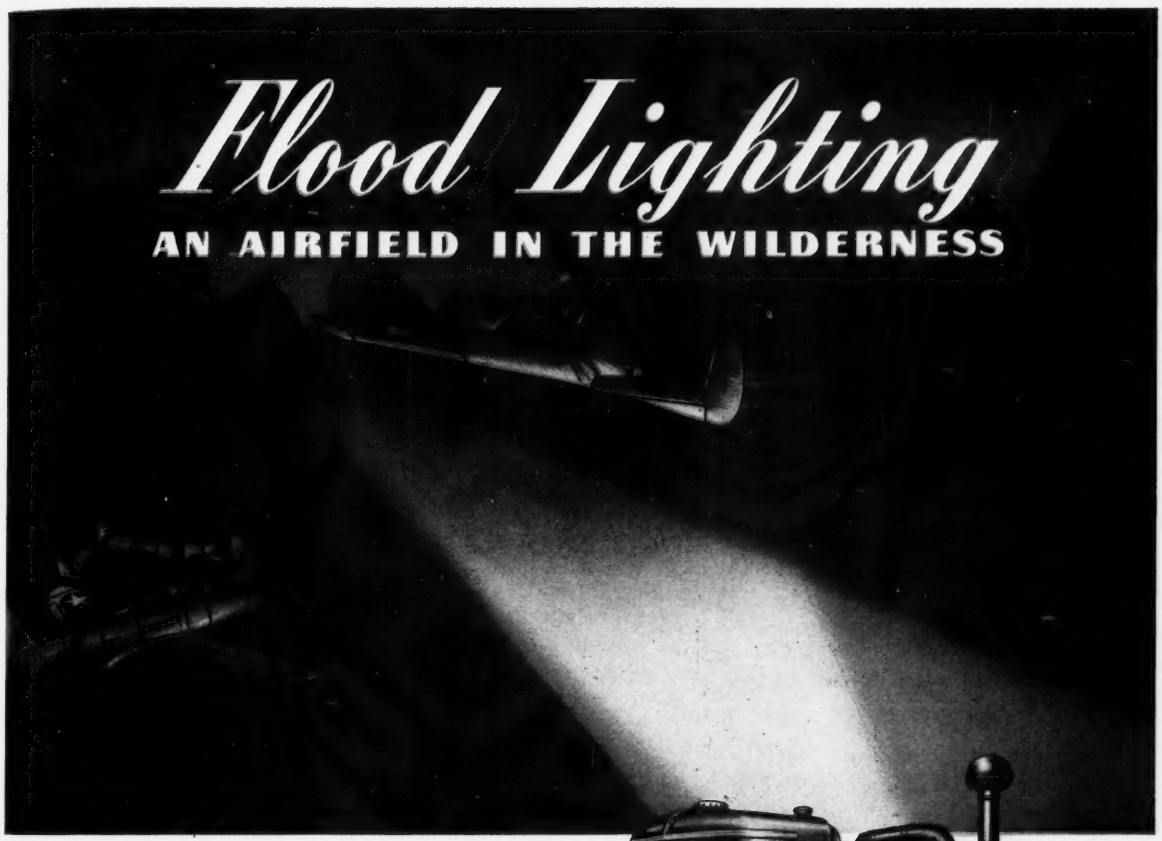
BY INCREASING the leakage path and incorporating a new type of contact, the current characteristics of a new series of Multi-Contact Plugs and Sockets, designed by Howard B. Jones, 2460 W. George St., Chicago 18, Ill., has been materially improved. This new line is known as the No. 2400 Series and is interchangeable with their present No. 400 Series.

The plug and socket bodies are of Bakelite having high insulating qualities with maximum strength. Sizes range as follows: 2, 4, 6, 8, 10 and 12 Contacts and are furnished with either a Shallow Bracket for flush mounting, Deep Bracket for recessed mounting or with Metal Cap with or without Cable Clamps.

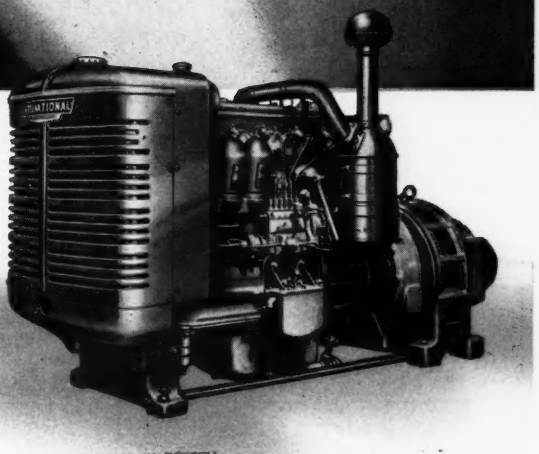
An entirely new type of Socket Contact has been developed. Four individual flexing surfaces make contact with each

Flood Lighting

AN AIRFIELD IN THE WILDERNESS



IT is black . . . solid black . . . at night . . . in the wilderness. To take off—he must see the field and those trees out yonder. You can't take a fighter into the air without light. A signal is flashed . . . a moment later there is a flood of light. He is up! His way is plainly marked and he can see the forest beyond. The rest is easy for him. BUT WITHOUT LIGHT . . . he would be grounded . . . at night . . . in the wilderness.



READY-POWER DIESEL ELECTRIC
Generating Plants

provide power for industrial as well as military service; power that is dependable, instantly available, whenever and wherever needed. They generate the electric current to light runways, flash signals, operate searchlights, turn lathes, and perform other innumerable functions.

RP engineers will give consulting advice upon your written request for information. Please state the details of your requirements.

FOR INDUSTRIAL AND COMMERCIAL USES

READY-POWER PLANTS are available for use at farms and ranches; urban or rural gas stations; machine and repair shops; to manufacturers in small towns; for street-lighting villages; to electric users looking for low-cost, economical primary or auxiliary current. Write for illustrated and descriptive Bulletin.

THE READY-POWER CO.

3861 GRAND RIVER AVENUE
DETROIT, MICHIGAN, U. S. A.

GOT A WATER SCALE PROBLEM?

Solve it with SOL-VET "08"

SOL-VET "08" is a fast, efficient cleaner of scale, rust, slime, dirt, algae for all equipment using water for cooling. By dissolving impurities completely, they are carried out *in solution,* thus preventing clogging. Head pressures fall to normal; heat transfer is raised to maximum; full circulation is restored; life of equipment prolonged. On large jobs, shutdown time is cut to a maximum of 6 to 8 hours.

GUARANTEED EFFECTIVE
If you find SOL-VET "08" is not exactly as represented, when used according to instructions and full, accurate report is given within 30 days from date of purchase, your money will be refunded in full.

GUARANTEED HARMLESS
when used as directed, to all water conducting materials used in water cooled equipment.

MAIL COUPON NOW
for complete data, and analysis and recommendations for your specific problem. No obligation, of course.

FILL IN AND MAIL COUPON
—you're not obligated

ANDERSON-STOLZ CORPORATION
1733 WALNUT ST. KANSAS CITY, MO.

☐ Please send complete data on SOL-VET "08."

☐ We are forwarding water sample and mechanical data—please send analysis and recommendations.

NAME_____

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ADDRESS_____

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SOL-VET "08"
Water Treatment Formula
Manufactured and Guaranteed by
ANDERSON-STOLZ CORP.
1733 WALNUT STREET
KANSAS CITY, MISSOURI

CLASSIFIED ADVERTISING

POSITION WANTED

Mechanical Engineer, aged 33, industrial and power experience. Started new High Pressure Powdered Coal utility as operator and control man. Desires plant engineer position in medium sized plant in Midwest. Am now employed. Address Box 1426, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

BUY MORE
WAR BONDS NOW

OPPORTUNITIES OFFERED

SALES MANAGER WANTED

Boiler feed water treatment and allied boiler and engine room products. Experience this line essential. Salary plus over-riding, excellent opportunity for right man. Old established concern. Our people know of this ad. Give full particulars in your reply which will be regarded as strictly confidential. Box 1428, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

Plug Prong. Due to the design, each segment makes positive contact over practically its entire surface providing increased contact area and smoother action. Projections on all four sides of the Socket

Contact, as shown in the illustration, lock it into position when forced into the Contact Pocket and prevent any up and down movement whatever.

The Socket Contacts are of Phosphor bronze, silver plated. The Plug Contacts are of Brass ¼ by $\frac{1}{16}$ in. silver plated.

Fuel Oil Purifier

DESIGNED TO EFFECTIVELY handle the purification of refined or crude Diesel fuels at the high rate of flow that is necessary in this type of installation, the Honan-Crane Corporation of Lebanon, Indiana, announces its single and multiple unit fuel oil purifiers. These units contain no moving parts and can be directly connected to purify the fuel immediately before it enters the engine or used in any kind of bulk station installation.

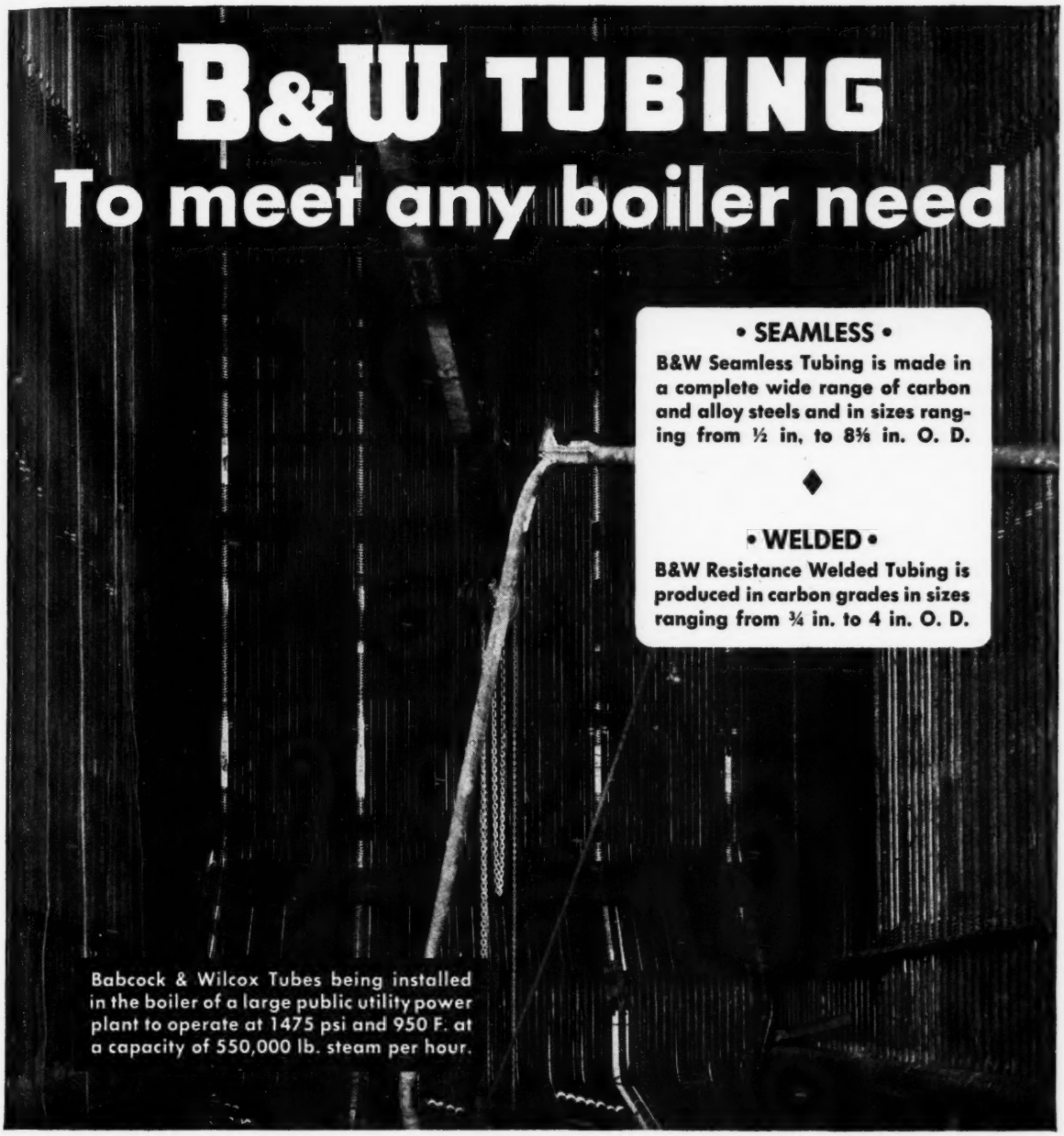
The purifier is designed on a flexible arrangement that provides for the grouping of single elements in combinations of 1-3-5-8-12, and is obtainable with or without heater bands and insulation. Elements are simple to remove and refill, a stand being provided with each unit for using bulk refills. Operation is entirely automatic with the exception of changing refills.

Standard units range in size from 12½ to 39 in. in diameter and from 44¼ to 57¼ in. in height. The flow rate is based on a single unit and the multiple units increase the flow rate in direct proportion to the number of elements used. Standard units will handle any size of Diesel engine on a direct connected installation and any type of bulk station use.

Packless Flexible Fastener

A NEW DEVICE, known as the packless flexible fastener, combining the functions of a supporting strap and a vibra-

B&W TUBING
To meet any boiler need



• SEAMLESS •

B&W Seamless Tubing is made in a complete wide range of carbon and alloy steels and in sizes ranging from ½ in. to 8⅝ in. O. D.

◆

• WELDED •

B&W Resistance Welded Tubing is produced in carbon grades in sizes ranging from ¾ in. to 4 in. O. D.

Babcock & Wilcox Tubes being installed in the boiler of a large public utility power plant to operate at 1475 psi and 950 F. at a capacity of 550,000 lb. steam per hour.

Whatever requirements you have for boiler tubes The Babcock & Wilcox Tube Co. can meet your specifications. B&W engineers, backed by more than twenty years' experience in the manufacture of tubes, plus modern, expanded production facilities, are always at your service for advice on your requirements —either for new designs or for maintenance.

★ BACK THE ATTACK— BUY MORE WAR BONDS! ★

THE BABCOCK & WILCOX TUBE CO.

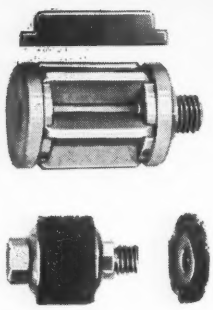
SEAMLESS DIVISION • BEAVER FALLS, PA.

WELDED DIVISION ALLIANCE, OHIO

TA-1263

Powerful - Fast

ROTO Junior Tube Cleaners for small tubes



For cleaning light scale from very small tubes, the fully self-contained Roto Junior Tube Cleaner offers advantages possessed by no other type. It is built with watch-like precision on the same time-tested principles as our large cleaners. The unusual power for its size is due to the positive contact between the solid blade and Rotocentric bore cylinder, which provides an undivided air stream and freedom from leakage. Roto heads and brushes have quickly-replaceable, inexpensive wearing parts which reduce greatly the cost of operation.

Simple Construction

A shaft and solid blade are the only moving parts in the Roto motor.

The ROTO Company

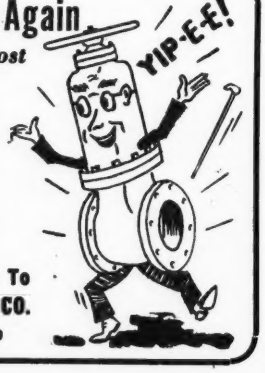
145 Sussex Ave. Newark 1, N. J.

Get Old Valves Back On Their Feet Again

—at less than half of the new valve cost

FOR VICTORY'S SAKE reclaim all your Iron, Steel or Brass valves. Every old valve put back in service means that another new one is available for vital war industry—to keep production lines flowing.

Send us those leaky old gate and globe valves you had planned to discard. Our experienced "Valve Doctors" will repair worn seats, discs and other parts. Our charges never exceed 50% of the original valve price; and they usually run around 35%. We pay shipping costs both ways on valves that can't be fixed.

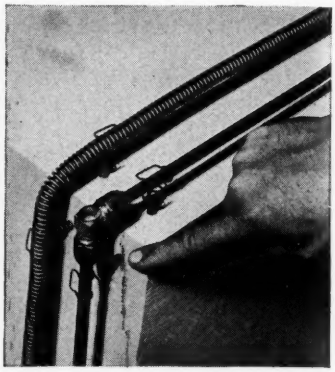


For Victory, Salvage Old Valves — Send Them To

THE COMBUSTION EQUIPMENT & INSULATION CO.

Factory at Greenlawn and Erie R. R. Tracks, Lima, Ohio

tion absorber for stationary or movable tubing, has been added to the line of the Packless Metal Products Corp., New Rochelle, N. Y. This fastener was developed at the request of aircraft builders who desired a simplified and improved hose strap that would eliminate the whip of hose in airplane engines, and it is equally well adapted to application in the railway, refrigeration and other industries.



The fastener consists of a sensitive spring, cone-spiraled and terminating in a clip which snaps on to the tube or similar unit to be fastened, the right size fastener being chosen to fit the O.D. of the unit. The fastener is affixed to a supporting surface by means of standard or wood screw fitted through the cone. Inasmuch as it flexes in all directions, the fastener can be installed in either lateral or vertical position. Its small hose area both facilitates placement and gives a large working area to the cone. Should it be necessary at any time to adjust or disconnect one end of the hose, the fastener also provides convenient elongation or contraction to facilitate this operation or that of reassembly.

New Detergent Type Lubricating Oil

DEVELOPMENT of a new detergent type lubricating oil which will reduce wear and assure engine cleanness and oil stability for low speed Diesel engines has been announced by Standard Oil Co. of Indiana.

Many engines give clean operation with conventional oils, but where dirty operation cannot be corrected by mechanical adjustment, the new detergent type lubricating oil can be used, according to Standard Oil engineers. The new oil will thus prevent ring-sticking, piston scuffing and excessive sludge and gum deposits. The detergency results from the use of an additive which is both a detergent and an oxidation inhibitor.

When a lubricant without detergency is used, carbon and other products of oxidation, as well as dirt, stick to each other and to engine parts. They deposit in rings and on valves and clog filters. With the new detergent type lubricating oil for low speed Diesels, however, a film coats the carbon and dirt, prevents particles from sticking and holds them in suspension until they are trapped by a filter or drained from the engine, according to Standard Oil engineers.

Quick Answers

ON SWITCHGEAR APPLICATIONS

Today, when every minute of production time gained brings Victory that much closer, the Westinghouse TWO-FOLD Switchgear Service puts application on a wartime basis. It insures getting the *right* switchgear in the *minimum* time with the *least* expenditure of Critical Material.

1

B-3035 Heavy-Duty Oil | B-2273 Light-Duty Oil
B-3036 Heavy-Duty Air | B-2296 Low-Voltage Air

..THESE FOUR BOOKS ON "UNITIZED" SWITCHGEAR

will save 30% of the time usually required to order, build, and install switchgear. Nowhere else can you find so much factual, easy-to-use switchgear information.

To order "Unitized" Switchgear, just (1) select units by number, (2) draw a single-line circuit diagram and specify capacities.

2

.. APPLICATION ENGINEERS ARE AT YOUR CALL...

Always at hand to help, is a country-wide organization of Westinghouse Application Engineers and Switchgear Specialists. They will answer promptly all questions on the best way to handle a job. Use them to expedite selection and ordering. You can reach them at your nearest Westinghouse Office.

***"UNITIZED"** switchgear makes expansion quick and easy.* New power requirements can be handled in a fraction of the time previously required. Ordering and manufacturing time are greatly reduced *and installation time has been cut as much as 60%*. Recently, a new unit was added to a "Unitized" Switchboard. Only 6 hours installation time was required instead of the 16 normally required with custom-built switchgear.

* * *

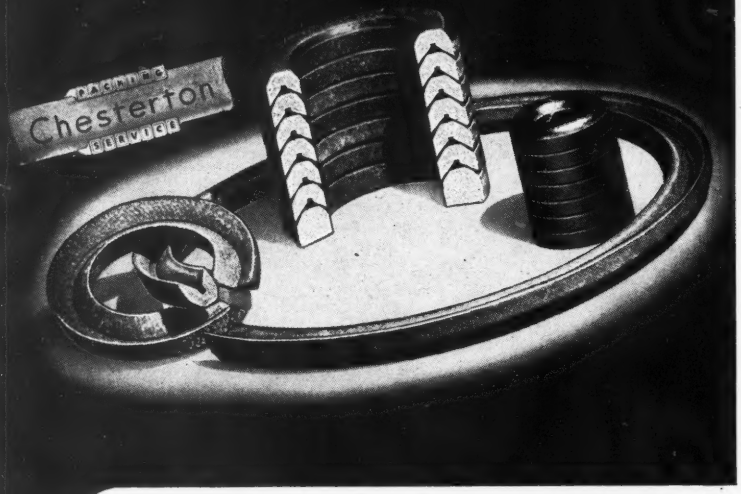
Take advantage of this TWO-FOLD Service. Call your nearest Westinghouse Office. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. J-60528

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

"UNITIZED" SWITCHGEAR

Drop Plant Maintenance Costs with
CHESTERTON
Parachute Packing



IT will pay you to specify Chesterton Parachute Packing on your hydraulic rams, high pressure engines, and pumps, hot or cold oils, rubber solvents . . . It is fully automatic, needs no bothersome after-adjustments, holds a tight seal, brings sharp drops in plant maintenance costs . . . Sold in all principal cities by *Factory-Trained* Distributors. Write for Catalog 20-E. It contains helpful Packing-Selector chart.

A. W. CHESTERTON CO.
64 INDIA STREET, BOSTON, MASS.
FACTORIES: MELROSE, MASS., CHICAGO, ILL.

BACK THE ATTACK
WITH WAR BONDS

OBITUARIES

E. J. Berggren

ERNEST J. BERGGREN died at Schenectady, New York, on September 9, at the age of 80 years. He was the oldest of the Edison pioneers and the last surviving member of the group that worked with the famous inventor at Menlo Park.

Mr. Berggren started work at the age of 16 as an office boy for a patent medicine company in New York City. His association with Edison began in 1880 when he went to Menlo Park, N. J., to help the inventor's bookkeeper with the office work. At that time there were about 75 men employed in the Menlo Park laboratory.

When the machines and other equipment of the Edison Works were transferred to Schenectady in 1886, Mr. Berggren moved there with Edison and other associates. In 1889, several of the Edison companies were merged to form the Edison General Electric Co. at Schenectady, and Mr. Berggren became head accountant of the Edison interests.

Upon consolidation of the Edison General Electric and Thomson-Houston Electric Companies in 1892 to form the General Electric Co., he was promoted to head accountant of the new company's Schenectady plant. Mr. Berggren resigned this position in 1901 to become secretary-treasurer of Thomas A. Edison, Inc., in Orange, N. J. He retired in 1924 when Mrs. Berggren died, and later entered the insurance field at Schenectady.

Robert W. Suhm

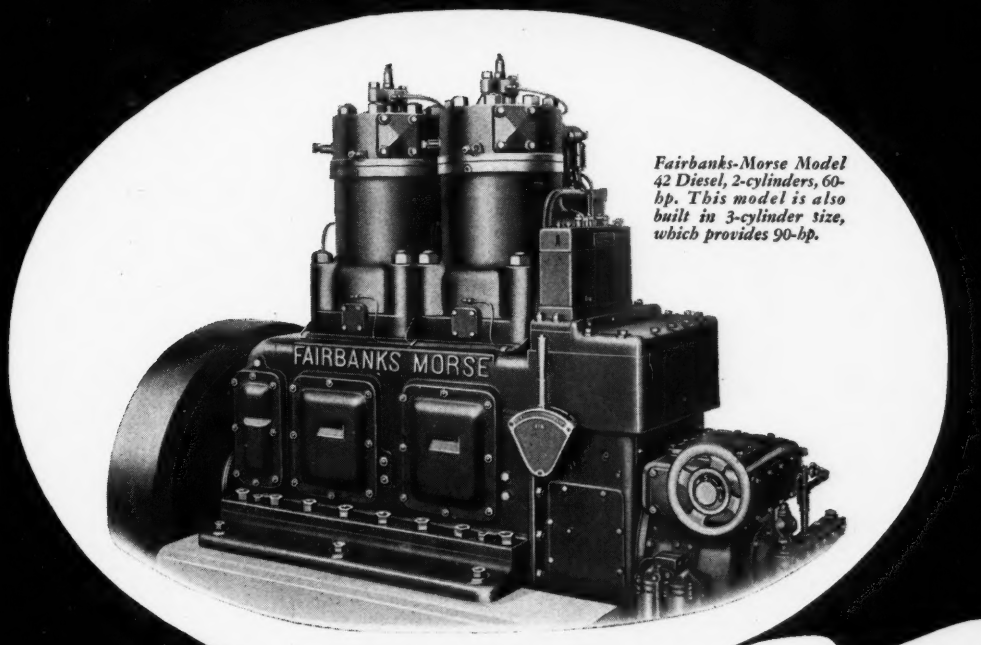
ROBERT W. SUHM, 60, vice-president of the Suhm Company, Inc., Milwaukee, Wisconsin, died August 23 after a heart attack at the firm's plant. Mr. Suhm was a member of the National Association of Power Engineers, Milwaukee chapter, and well known for his work in the brewing industry.

Survivors include his father, John J. Suhm, 94; his wife, Mrs. Margaret Lotz Suhm; four brothers, Herbert, Arthur, Edgar and Clarence, and two children, Sergeant Ralph and Alice.

F. H. Rosencrants

F. H. ROSENCRANTS, vice president of Combustion Engineering Company, Inc., and a recognized international authority on steam power plants and boiler design, died suddenly at his home in Scarsdale, N. Y., August 26.

A graduate of the University of Nebraska in mechanical engineering and later professor at Oregon State College, Mr. Rosencrants subsequently became associated with the design of utility power plants, serving as mechanical engineer of the Texas Power and Light Company, and, from 1918 to 1924, of the Electric Bond & Share Co. During the last two years of his service with the latter company he was in charge of the design of steam power stations.



Fairbanks-Morse Model 42 Diesel, 2-cylinders, 60-hp. This model is also built in 3-cylinder size, which provides 90-hp.

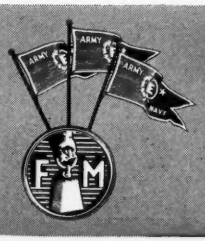
WHY THIS DIESEL

for small power requirements?

● You don't have to sacrifice dependability just because your power requirements are relatively small. And if you put a Fairbanks-Morse Model 42 Diesel on the job — you enjoy the same trouble-free operation possible with larger Fairbanks-Morse installations.

Fairbanks-Morse Model 42 Diesels are built specifically to deliver 60 to 90 horsepower continuously. They provide the small power user with Diesel dependability — and at typical Diesel economy. They are 2-cycle, slow-speed, heavy duty, full Diesel engines. There are no valves to require periodic grinding. Lubrication is completely automatic. Working parts are enclosed, yet easily accessible. No special knowledge or special attendant is necessary to start and operate them.

Get complete information about Fairbanks-Morse Model 42 Diesels now — they're the "little brothers" of the world-famous Fairbanks-Morse Model 32 Diesels. Fairbanks-Morse & Co., 600 S. Michigan Ave., Chicago. Branches with service stations throughout the United States and Canada.



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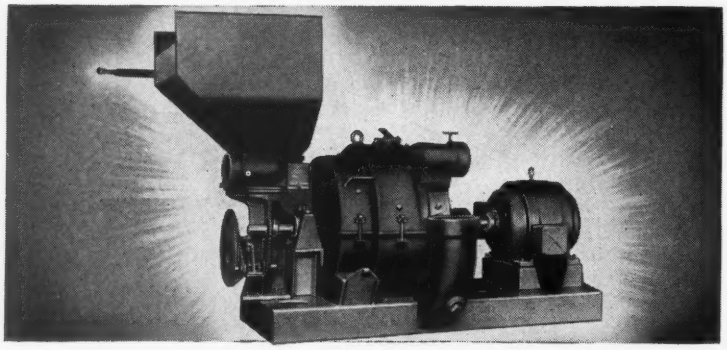
DIESEL ENGINES · WATER SYSTEMS
PUMPS · SCALES
MOTORS · STOKERS
GENERATORS · FARM EQUIPMENT
RAILROAD EQUIPMENT

F M Diesels



THE MODERN Sims-Pettibone Unit System of pulverization is applied successfully to boilers, metallurgical furnaces, kilns, stills, incinerators, dryers, etc., and is firing and burning bituminous coals, lignite coal, tar pitch and sewage sludge. Operating cost data on all of these experiences are available to help determine the value of an S-P Pulverizer for your plant. Write for booklet.

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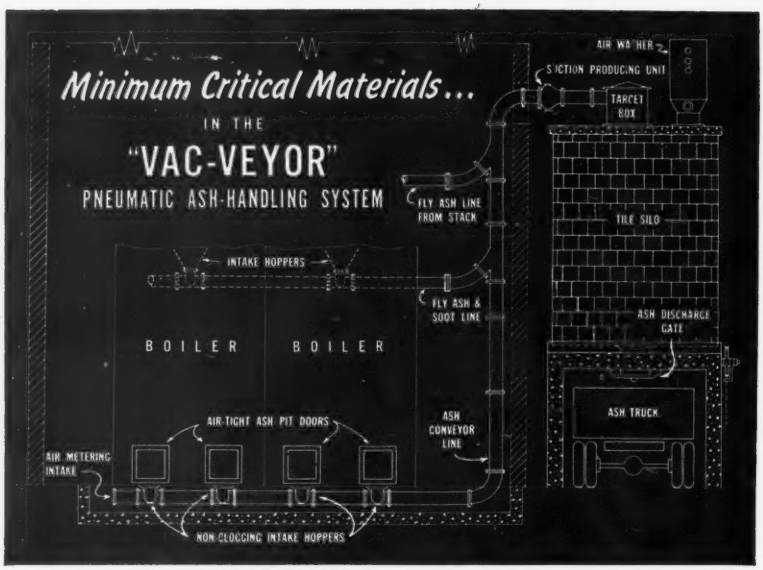


Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

In 1924 he went to England to become Director of Engineering of International Combustion Engineering Co., Ltd., London. He served in this capacity for the next six years during which period he supervised the design and construction of notable steam power installations in Great Britain and many other countries. Returning to the United States in 1930, he became vice president of Combustion Engineering Co., Inc., New York. In this capacity he was in charge of some of the company's most important activities, including the development of the standard VU design of steam generator for a wide range of capacities, and the development of chemical recovery units for pulp mills. He was also identified with the design of the first large forced circulation boiler to be installed in this country—the 650,000 lb per hr, 2000 psi unit placed in service at the Somerset Station of Montaup Electric Co. about two years ago.

MANUFACTURERS' PERSONALS

C. H. Linder was appointed assistant manager of General Electric's Schenectady works on August 1. A graduate in electrical engineering of the University of Texas, he entered the employ of the company in 1924 as a student engineer on the "test" course at Schenectady.

He was appointed special assistant on the Schenectady works manager's staff in 1935, and the following year became assistant superintendent of the Industrial Control Department. From 1938 to 1942 he was superintendent of the Searchlight and Ordnance and Hydraulic Control Departments.

C. H. Linder **F. T. Lewis**

Effective the same date was the appointment of F. T. Lewis as assistant to the manager. Since 1940 Mr. Lewis has been production manager at the West Lynn Works. He entered the employ of the company in 1916 as an apprentice. After serving two years' apprenticeship he left to attend Tufts College, from which he received a B.S. degree in 1922. That year he returned to the West Lynn works where he was assigned to experimental mechanical work. In 1925 he was appointed foreman in the Transformer Division and in 1929 was appointed assistant to the general superintendent in co-ordinating cost reduction activiites in the works. He was appointed production manager in 1940, which post he relinquished to become assistant to Mr. Howell, works manager.

J. W. Belanger, manager of the Federal and Marine Divisions of the General Electric Company, has announced the appointment of Alexander Kennedy, Jr., as assistant to the manager in charge of engineering and Howard P. Bish as assistant to the manager in charge of administrative

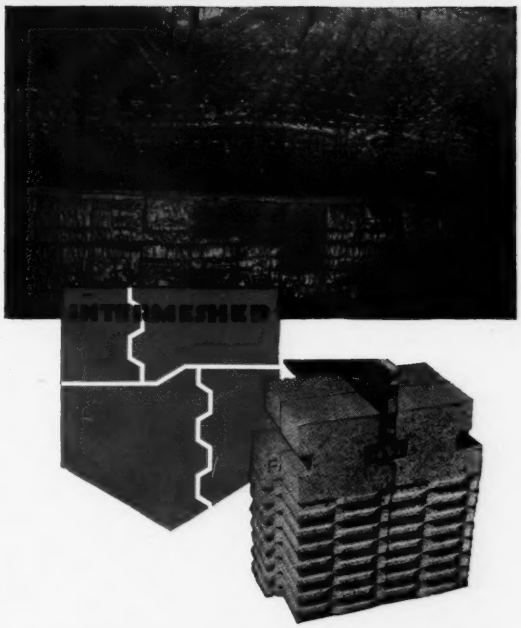
On Present Boilers . . . or New

Many power plants have found that a Detrick engineered furnace enclosure will permit them to work their existing equipment at higher capacity and yet have less outage for wall and arch repairs.

Long life under severe service is an old story among Detrick users. The photograph at the right demonstrates how a Detrick Arch can "stand the gaff," even under heavy loads. It is the soundness of Detrick engineering that makes this possible . . . engineering involving many principles learned the hard way through actual practice . . . thirty years of concentration on the one problem of enclosing heat.

One of these principles is the Detrick Tile design. All tile are faced with treads and intermeshed. Even though the corner of an individual tile may crack off the treads hold it in position and maintain the full thickness of refractory over longer periods.

If yours is the problem of getting more out of present equipment, talk it over with the Detrick man. If it's enclosing heat, he can help you.



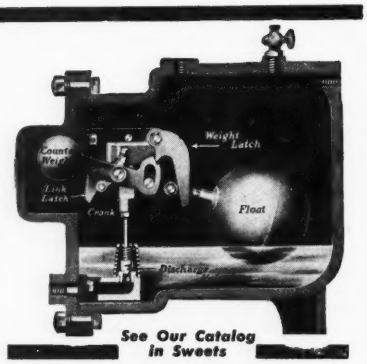
Detrick Suspended Arches and Walls as applied on many different types of boilers and furnaces are described in the new 80-page catalog just off the press. It is practically a textbook on the subject of enclosing heat, presented in a way every engineer will like. Your copy is available on request.

M. H. DETRICK COMPANY
140 SOUTH DEARBORN STREET, CHICAGO

DETRICK FURNACE ENCLOSURES

NICHOLSON Weight Operated Traps make sure there are no slackers on your steam lines ★ ★ ★ ★

Positive automatic intermittent action. Large capacity. Pressures to 1500 lbs. at 1000 degree max. temp. Sturdy Design — Dependable Mechanism — not easily affected by dirt, scale, pulsation, vibration, variation in pressure, or other adverse conditions. Quick Opening and Closing Valve—no wire-drawing. Water-Sealed Discharge — impossible for steam, air or gas to escape. Hardened Stainless Steel Valves and Seats — interchangeable for all pressures. Meets ALL requirements of modern high pressure power plants.



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See Our Catalog in Sweets

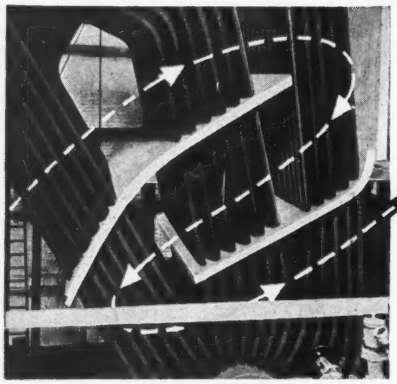
W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON Traps

THERMOSTATIC ▼ PISTON AND WEIGHT OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼ ▼ ▼

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

ENCO BAFFLES



Satisfy Hungry Heating Surfaces

...and many boiler heating-surfaces are literally and unnecessarily starved. They need Enco Baffles to increase heat absorption, to boost efficiency and to increase steam output. Enco Baffles revitalize boilers by providing streamlined cross-flow of gases over the tubes, and by eliminating eddy currents, bottlenecks and dead gas pockets. Bulletin BW40 gives further details. It is yours on request.

THE ENGINEER COMPANY

75 WEST STREET (Enco) NEW YORK, N.Y.

affairs. Both are newly created positions.

Mr. Kennedy, a graduate of Cornell who has been associated with General Electric since 1908, has been identified with marine affairs since 1919. For the past 10 years he has been the application engineer on main propulsion turbines and gears designed and manufactured for the new Navy combat vessels.

Mr. Bish was graduated from Ohio State University in 1919. The following year he was transferred to the Marine Engineering Department and later was appointed proposition engineer of the department. In October 1940 he was placed in charge of the Navy Ship section of the Federal and Marine department, and in February 1942 was made manager of sales of the section, the position he held until his present elevation.

Harold D. Bates has been appointed assistant sales promotion manager of the industrial division of Johns-Manville Corp. Mr. Bates will direct sales promotion and advertising activities of the industrial division of the company, succeeding E. A. Phoenix who has taken an executive sales position.

Arthur A. Brandt, George W. Henyan, and V. M. Lucas have been appointed to new positions in the Electronics Department of the General Electric Co. Mr. Brandt has been made General Sales Manager. In this capacity he will be responsible for the co-ordination of the sales plans and policies of the several divisions, and the operations of the Electronics Department district offices. Mr. Henyan has been made Assistant to the Vice President of the Department, and Mr. Lucas has been appointed Manager of the Government Division.

Armin L. Nevers has been appointed by The Osborn Manufacturing Co., Cleveland, Ohio, as its technical representative in the State of Wisconsin, following through in the development of a territory in which he has already had many years of sales experience.

B. M. Horter, has been appointed new purchasing head for Cutler-Hammer, Inc., Milwaukee, manufacturers of Motor Control Apparatus. In his new duties Mr. Horter will have direct supervision of all purchasing activities. Mr. F. W. Wilhoit, former purchasing head, has retired after forty-one years of service with the company.

Worthington Pump and Machinery Corp. announces that L. E. Hammer has joined the organization as Assistant Works Manager of its Moore Steam Turbine Division, Wellsville, New York. A 1923 graduate of the University of Pittsburgh, his experience has been chiefly in the field of steam turbine manufacture.

Cutler-Hammer, Inc., Milwaukee, has announced the appointment of P. S. Jones as General Sales Manager for the company. In his new duties Mr. Jones will have direct supervision of sales for the company through its thirty selling territories throughout the country.

Mr. Jones first became associated with the company at Milwaukee as a sales engineer in 1915, and he was transferred to the Pittsburgh office in 1919, where he was later appointed as Branch Manager of the Pittsburgh sales territory. For the past fourteen years prior to his new appointment Mr. Jones was in charge of the New York sales territory. He is a graduate

To keep control costs DOWN

KEEP UP WITH McALEAR

Precision Controls for Regulating...

PRESSURE

FLOW and LIQUID LEVEL

TEMPERATURE

HOW TO USE McALEAR SERVICE

Look to McAlear for leadership and pioneering in the field of pressure valves and fluid transport controls. For precision engineered control devices that reduce down-time . . . and hold maintenance expense to an absolute minimum.

McAlear has never shied away from specification jobs requiring research and development. Nor do we even today. We continue to seek opportunities to design and develop special controls for specific applications.

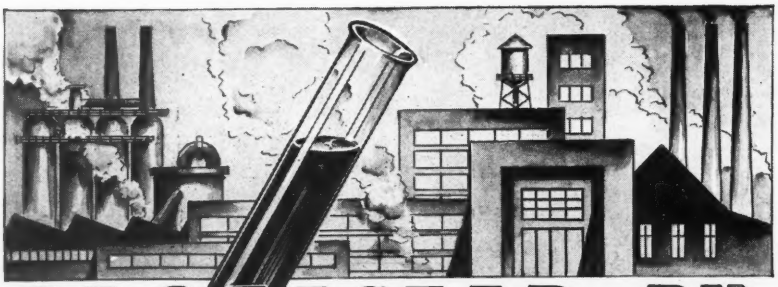
If you have a control problem call on McAlear engineers. Draw on their fund of experience, on their ability and readiness to help you, whether for wartime application or post war planning. For informative bulletins and catalog, write McAlear Manufacturing Company, 1915 S. Western Ave., Chicago.

McALEAR

PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

controls

for STEAM, WATER, AIR, OIL AND GAS



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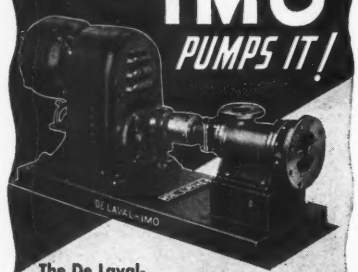
Protect your plant against corrosion, the destroyer of piping systems, boilers and condensers. Corrosion scale retards heat transfer and lowers efficiency. Call in a Haering engineer without obligation, and let him show you how Haering Glucosates save you money and increase production. Or write for these booklets . . .

"Organic Methods of Scale and Corrosion Control"
"Water Studies"
"Water Treating"

WE READ WATER

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive Chicago, Illinois.

THICK or THIN
IMO
PUMPS IT!



The De Laval-IMO ROTARY DISPLACEMENT PUMP is used for viscosities ranging from that of thin Diesel oil up to the heaviest Bunker C. In the unit here shown, which handles a still stiffer fluid, the outboard end of the pump forms the suction opening, reducing inlet velocities and losses to negligible amounts. The output is controlled by the variable speed drive. • The IMO pump has no valves, no gears and no unbalanced or reciprocating parts. It pumps any oil against any pressure.

Ask for Publication I-103

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

In Cooperation With

THE POST OFFICE

. . . we will appreciate it if you will add our new zone number (4) to all mail addressed to us, as shown below:

POWER PLANT ENGINEERING
53 W. Jackson Blvd.
Chicago 4, Illinois

As you know, the new Post Office zone delivery system has been adopted to expedite the delivery of mail. Simple in operation, its success depends on the cooperation of all mailers.

of the Ohio State University where he obtained his B.E.E. in 1915.

W. F. Rauber has been appointed Manager of Sales of General Electric's Outdoor and Station Equipment Section. Mr. Rauber has been associated with General Electric since 1923 and became a Switchgear Specialist in the company's Cincinnati office in 1928, later in Cleveland then in Philadelphia. In recent years he has been General Assistant in the Power Circuit Breaker Sales Section.

William J. Conley, former chairman of the Engineering Department of the University of Rochester, has been appointed consulting engineer of the Lincoln Electric Co. He will act as a welding consultant for various industries, handling problems on mechanical and structural design utilizing welding, as well as metallurgical problems involving welding processes.

John G. Seiler has been elected vice-president of Tube Turns, Inc., Louisville, Ky. Mr. Seiler has been sales manager of the company and will continue to perform these duties.

Paul Dietz has been appointed export sales manager for the general machinery division of the Allis-Chalmers Manufacturing Co. Mr. Dietz comes to Allis-Chalmers from the export division of the B. F. Goodrich Co., Akron, Ohio. During the 15 years he was with Goodrich, Dietz was stationed in Mexico, China and French Indo-China.

MANUFACTURERS' NEWS

Army-Navy "E" Awards

The Briggs Clarifier Co.
Bethesda, Md.
The Bristol Co.
Waterbury, Conn.
Buffalo Pumps Incorporated*
Buffalo, N. Y.
Jenkins Bros.*
Bridgeport, Conn.
Link-Belt Company
Pershing Road Plant, Chicago
Phelps Dodge Copper Products Corp.
Los Angeles plant
Warren Steam Pump Co., Inc.
Warren, Mass.

*Second star added for sustained high achievement in production of war equipment.

Republic Flow Meters Co., Chicago, Ill., has recently been honored by being invited to become a member of the Rice Leaders of the World Association.

Public Service Corp. of New Jersey has created the post of Executive Vice President and elected George H. Blake to the new position. Mr. Blake, who joined Public Service in 1910 as a trial attorney has been Vice President and General Solicitor of the Corporation and its subsidiaries for the past six years. He has been a director of the Corporation since 1934 and a member

New Gulf Coast State Utility Plant of Outdoor Type Is Equipped with Ljungstrom Preheater

Here's a boiler plant in which fuel savings are backed up by sound conservation of steel and other structural materials. Designed for natural gas firing, it has a maximum continuous rating of 425,000 lb steam per hr. Operating pressure is 900 lb per sq in. Gases enter the preheater at 775 deg F, leave at 370, and heat the combustion air to 632 degrees. Preheater and fan assembly are installed out in the open between the steam generator and stack.

• • • • •

Ljungstrom Air Preheaters save fuel two ways. First, they recover heat that would otherwise be lost up the stack, increasing efficiency of the plant by 6 to 10 percent. Second, they provide more effective combustion conditions, a factor of particular importance in burning lean fuels. In some cases, preheating of combustion air makes it possible to use fuels that would otherwise be unsatisfactory.

At the same time, this compact *regenerative* type of preheater saves appreciably on steel and construction materials. First, because optimum heat recovery is obtained with *one-half* to *one-third* the weight of steel in the preheater itself, as compared to other types. Second, because lower weight and compact design permits a simple supporting structure.

Today, the *conservation* features of the Ljungstrom are expanding its application from high-efficiency boiler plants to a wide range of industrial applications where gas-to-air heat transfer can save fuel and improve combustion. These applications include oil heaters, metallurgical furnaces, and the like.

For the complete story on the operating principle and construction features of the Ljungstrom Air Preheater, write for a copy of Bulletin S-1.

For **PRODUCTION ACHIEVEMENT . . .**

The U. S. Maritime Commission has awarded its "M" Pennant and Victory Fleet Flag to the men and women of Air Preheater Corporation.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York

BRICKSEAL

Protects The SURFACE
Saves The BRICK

• Forms a Highly-glazed Vitrified, Monolithic Surface

A simple application of Brickseal, with brush or spray gun, protects your refractories against cracking, spalling and deterioration due to sudden changes in temperature, slagging, clinkering, and flame abrasion.

Boiler is ready for operation immediately after application of Brickseal. Heat of furnace vitrifies Brickseal permanently into all pores, cracks and joints, and forms a highly-glazed, monolithic coating. Brickseal cannot crack, peel or blister due to sudden temperature variations because it remains semi-plastic until boiler cools.

Write for sample or Brickseal representative, today.

BRICKSEAL
REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

of the executive committee of the Corporation's board of directors since 1935. He started with Public Service in 1910 in Jersey City was made Assistant General Solicitor of the Corporation and its subsidiaries in 1921 and General Solicitor two years later.

During the first six-month period of 1943 the General Electric Co. accepted 11,395 ideas for saving materials or time in war production, or only 4,809 less than the entire 1942 total. The amount paid suggestors during the first half of 1943 was $127,515 as against $158,943 during the previous twelve-month period, highest annual figure since the G-E suggestion system was established in 1922.

Mrs. Edith Hogan of the company's West Lynn, Mass., plant received $1250, the highest award during the first six months of 1943. She suggested a plan for breaking a bottleneck in the production of carefully calibrated dials on electrical instruments much needed by the armed forces. Her idea of marking the scale on these dials mechanically, rather than by hand, saves 400 "woman-hours" a week.

Mrs. Anna Turnbull of the Bridgeport, Conn., plant received $900 for an idea which also saves hundreds of "woman-hours" and releases many skilled operators for other war work. At her suggestion, cotton wrappings on head-set cords used in military communications are now burned off by a hot wire in place of the slower method of clipping them off with scissors.

W. B. Myers, Jr., received a total of $915 for three ideas submitted. His largest award, $600, was for a suggestion which eliminated a machining operation as well as transportation between buildings in the manufacture of gears for vital war apparatus. The elimination of nine operations on another part resulted in an award of $300; his third award simplified the routing and handling of a part of another important device.

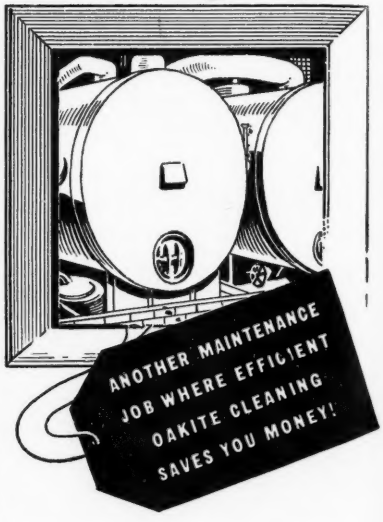
Orville Ellenwood of the Fort Wayne, Ind., plant was awarded $625 for suggesting simplification of connections in small transformers having war applications, thereby eliminating the assembly of several screws, washers and lock washers and thus saving both vital materials and man-hours.

John O'Brien was paid $500 for suggesting a new method of machining gears for ordnance.

The Metallizing Company of America announces the purchase of a new building, located at 135 Cedar Street, New York City as eastern headquarters for its sales and service operations in that area. The building is a complete operating unit with development and test laboratories, warehouse for metallizing guns, equipment, parts and wire, general service departments, as well as a demonstration shop, complete with equipment included in a typical operating metallizing set-up. V. A. Cook will continue in charge of eastern operations.

Dunbar Engineering Co., New York City, has been appointed sales representative of The Edward Valve & Mfg. Co., Inc., East Chicago, Ind., for the state of Connecticut, and W. E. Bowler, Philadelphia, as sales representative for the Reading, Pa., territory. Both the Dunbar Company and Mr. Bowler have represented the Edward Company for many years, and the new appointments increase the territory they will service.

Clean Evaporator Coils This Easy, Time-Saving Way!



Do you want an easier, faster way to remove lime-scale and oxidized deposits from your evaporator coils? Then investigate Oakite Compound No. 32, a material specially designed to HELP YOU solve this and related maintenance problems economically!

Due to its controlled scale-dissolving action, this remarkable material is far SAFER than commercial acids. Does its work thoroughly, quickly . . . without harming metal surfaces. Easy to use, too. Just circulate recommended solution through system as directed.

NEW BOOKLET FREE!

The revised third edition of this 20-page booklet gives further details . . . concisely describes safe, successful, low-cost methods for de-scaling and cleaning Diesel water jackets, "lube" oil and jacket water coolers, surface condensers, feed-water heaters. YOUR copy is FREE! Write for it today!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

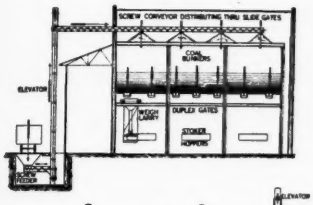
Your coal and ashes handling problem . . .

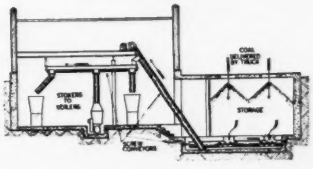
Manpower shortage?

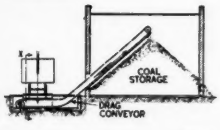
Converting from gas or oil to coal?

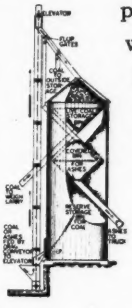
Old equipment?

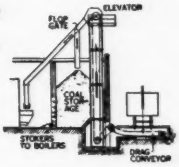
12 Typical Link-Belt solutions are illustrated

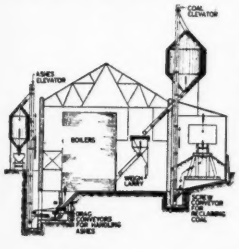


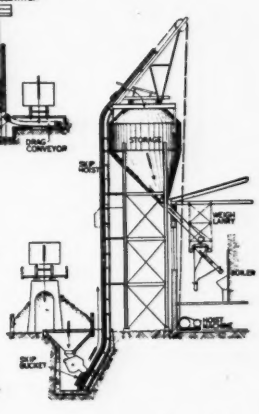


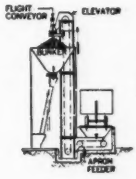


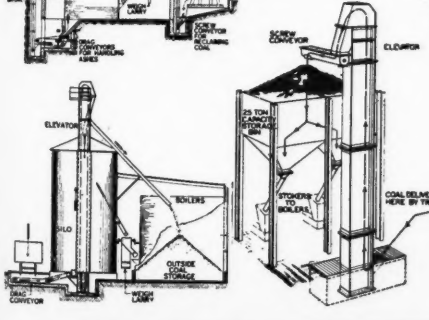


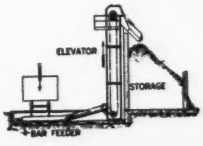


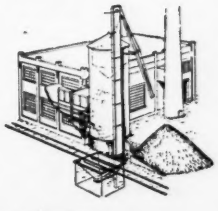












● Wartime exactions require revised thinking about coal and ashes handling. Fuel must be handled efficiently and man-hours saved in spite of stepped-up production. There is no one solution to the problem, so engineering skill and experience are needed in selecting the best type and arrangement of equipment to successfully meet each particular need. Whether your plant is large or small and no matter what your coal and ashes handling problem, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problems with an experienced Link-Belt engineer. Send for Book No. 1510, "Solving The Problem of Coal and Ashes Handling in The Boiler Plant."

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7 ADVANTAGES

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They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- **They warm up cold furnaces**
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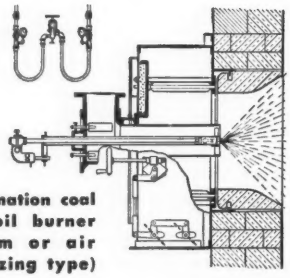
- **They permit operation with oil or coal—whichever is available and lowest in cost per BTU.**
- **All capacities of steam, air or mechanical-atomizing types are interchangeable**

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)

Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

NEWS FROM THE FIELD

One Million Fisher Controllers

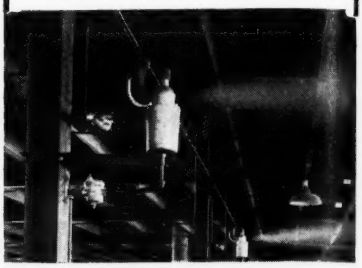
FISHER GOVERNORS are classical equipment, they have stood the test of time and are popular today in industrial plants throughout the entire country. This is attested to by the fact that on last July 14 the Fisher Governor Co., amid appropriate ceremonies in connection with the receipt of the Army-Navy E Award, unveiled the one millionth Fisher Controller to come from the factory of the company. It is designated as Fisher Type 435T Controller, Serial No. 1,000,000 and has been installed in a new aviation gasoline plant in Kentucky.

The first Fisher governor was built in 1880 and it was not until 1937 that the 500,000th unit was turned out by the factory in Marshalltown, Ia. In the six years that have followed another half million have been put into service. That is a lot of controllers, enough, allowing one foot width for each unit, to make a row over 189 mi long, or all the way from Marshalltown to Sioux City. Or if placed one on top of another, units averaging a foot and a half in height, they would make more than 100 piles the height of Pikes Peak or would fill a core in that mountain ten feet in diameter from the sea level to the very top. While these figures are spectacular the most important ones cannot be estimated—these are the tons of coal which have been and are being saved by these controller units that automatically maintain steam pressures at the optimum point.

Imperial Valley Power Project to Cost $6,000,000

IMPERIAL IRRIGATION DISTRICT, Imperial, Calif., is arranging plans for early acquisition of properties of California Electric Power Co., in Imperial and Coachella Valleys, including power plants, transmission and distribution lines, power substations and other facilities. A consideration of $4,900,000 will be given for all holdings of the company in these areas. New transmission will be constructed, with switching stations and other operating facilities for consolidation of acquired system with present lines of Irrigation District, with cost estimated at $750,000. A number of primary and secondary line extensions are planned in different parts of territory, with power

PREVENT "DRY-OUT-ITIS" due to winter heat



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IT'S EASY TO END the dry air problem. Prevent fiber breakage, warpage and checking of wood, shrinkage of paper, excessive static electricity, spoilage of certain foods, cracking of leather, weight loss, and other evils . . . with Armstrong Steam-Type Humidifiers. Many installed in offices to provide healthful, comfortable working conditions.

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AS LOW AS 2 CENTS PER HOUR!

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Troy-Engberg Power is *Low Cost* Power Because it's *By-Product Power*

THE Troy-Engberg Steam Engine rates high in dependability, economy and utility. Where plant conditions are favorable, it is the most modern drive for stokers, pumps, compressors, blowers, fans, generators and other boiler room and process plant equipment.

WHEN heat balances are favorable, the Troy-Engberg Steam Engine captures the "by-product power" in the steam. We can point to many units where the savings made possible by this "by-product power" have been large enough to pay for the entire cost of the engine in only a year or two.

And there are other values along with economy. The Troy-Engberg Steam Engine offers a very wide speed range amenable to automatic control . . . high starting torque and ability to handle overloads over long periods . . . freedom from fire hazard . . . and, under certain conditions, oil-free exhaust. It provides steady operation over a period of many years without requiring major repairs.

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Established 1870

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substation units and service connections, to cost approximately $205,000. These programs will be placed under way as soon as properties are taken over. In connection with this development, the Irrigation District has authorized surveys and plans for a new hydroelectric power plant at Pilot Knob on All-American Canal, and has appropriated a fund of $75,000 for engineering work for this project. Estimates of cost of development will be made soon. To provide for complete program noted, a bond issue of $6,000,000 is being arranged.

Cleveland Electric Company Completes Power Plant Expansion

CLEVELAND ELECTRIC ILLUMINATING Co., Cleveland, Ohio, has completed installation of a new 50,000-kw turbine-generator unit at its Avon generating station on Lake Road, fronting on Lake Erie, and will place in service at once. This is the third increase in generating capacity that company has carried out in such number of years, a turbine-generator installation at its Lake Shore plant, near Gordon Park, being completed in 1941, and another generator installed in this same station and placed in operation in 1942; the Avon expansion noted is now ready in 1943. The latter addition will increase the installed generating capacity of company at all plants to more than 800,000-kw. In conjunction with Avon plant extension, work has been in progress on a new 66,000-v underground transmission line between the Lake Shore power plant and Newburgh power substation, to provide increased capacity for latter unit. This installation is being completed and will be in operation at early date. The company, it is stated, is now furnishing power service to about 2500 industries in its territory, a large number of these being given over to war production at present time.

Columbia Basin Postwar Projects

UNITED STATES DISTRICT ENGINEER OFFICE, Pittock Block, Portland, Ore., is planning a postwar construction program in Columbia River basin district, and Col. Ralph A. Tudor, Portland Area Engineer, is in charge of details. It is proposed to secure a fund of $250,000 annually for a period of five years for projected work, which will include power development, flood control and navigation facilities. Bureau of Reclamation, Washington, D. C., and Bonneville Power Administration, Portland, will be actively interested in program, which will involve a total of $1,250,000 for time noted. Plans are now under consideration for construction of a power dam on the Row River, vicinity of Cottage Grove, Ore., previously projected and suspended when the war began. A storage dam on the North Santiam River near Detroit, Ore., is planned for early construction, and details will be determined at once. Other storage dams are projected on the South Santiam River in the Willamette Valley area, and on the Little Fork of Willamette River in same district.

Plans Maturing for San Antonio Station

BOARD OF PUBLIC SERVICE, San Antonio, Tex., has engaged Gibbs & Hill, Pennsylvania Station, New York, N. Y., consulting engineers, to prepare plans and supervise construction of proposed addition to municipal power plant, recently

Have You Tried FRANCE Metal Packing?

The France Representatives listed below are packing experts. They are experienced in the solution of engine pump and compressor packing problems that have to do with pressure, temperature, friction and lubrication. They are good men to know well. Tear out this list or at least the number nearest you. Keep it handy. Use it to your advantage.

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Original FRANCE METAL PACKING

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Actual photograph showing a 2 inch covering of GUNITE (*Pressure Concrete*) applied pneumatically to a 48 inch steel pipe line.

This is one of our recent jobs showing the adaptability of reinforced GUNITE on this type of work.

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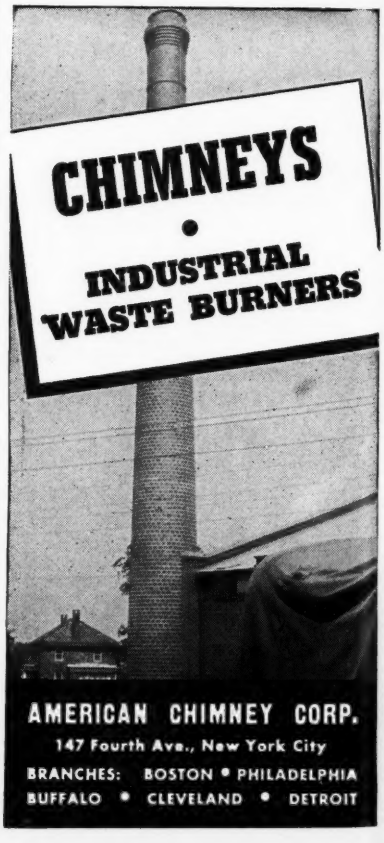

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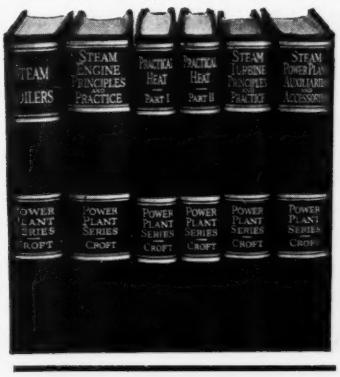
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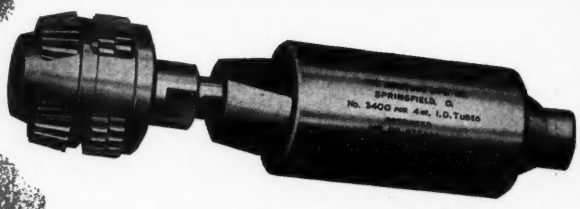

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You will find an extra something in Airetool Tube Cleaners. There is an unique power seal that saves power and permits the use of heavier cutter head combinations to combat severe deposits. The motor can be loaded down to 50 R.P.M. without stalling and it picks up quickly when power is applied. Put these Big Guns to work for you. WRITE FOR BULLETIN PP-14.

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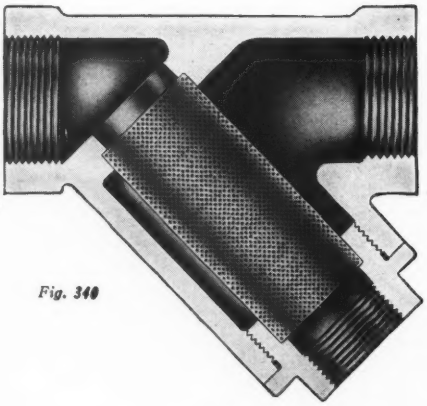

Fig. 340

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **Tube Cleaners**—New Bulletin V-16 tells about Vibratap cleaners for fire tube and water tube boilers. Vibrataps are driven by steam or compressed air and do good work with relatively low pressures. Brunt Equipment Co.

2 **Furnace Wall Data**—Charts to simplify the solution of heat-transfer problems in connection with refractories and high-temperature insulation are contained in a new 16-pg booklet, "Heat Transmission Through Furnace Walls." Curves on the ten full-page charts are plotted in terms of conductivity factors. The novel arrangement makes it possible to use the charts for firebrick, insulating brick, refractory concrete, plastic refractories or any refractory material for which the conductivity (K-factor) is known. The Atlas Lumnite Cement Co.

3 **Multiple Spreader Stoker**—"Burns Coal Like Oil" is the title of the new 12-pg board-bound brochure which describes the Fyr-feeder multiple spreader stoker and the work that it is doing in various Army, Navy and Defense Power Plants, as well as on oil conversion jobs. American Coal Burner Co.

4 **Integral Furnace Boiler** — Fully illustrated bulletin G-34A gives complete data on integral furnace boiler, either stoker firing or oil burning. Can be quickly converted to burn whichever is the more economical fuel. The Babcock & Wilcox Co.

5 **Hot Spot Indicators**—Detailed instructions for using hot spot indicators and hot spot quenchers in coal storage piles and bunkers, detailed description of the indicators and quenchers and diagrams showing how they should be placed are contained in a new publication, Bulletin 100. This also includes some notes on the storage of bituminous coal. Coal Specialties Co.

6 **Baffles**—Illustrated bulletin BW-40 gives the history and development of streamlined baffles with many diagrams showing their application to all types of boilers. The Engineer Co.

ELECTRICAL EQUIPMENT

7 **Gearmotors** — 16-pg bulletin GEA-1437D describes several gearmotors and indicates various locations where they may be used. It also contains descriptions of the mechanical features of these motors, the electrical characteristics of the polyphase motors which are built into them, and charts showing horsepower-speed ratings. General Electric Co.

8 **Electrical Control Motors**—Catalog A5 covers ATC Type 3 electrical control motors for temperature, pressure, flow, etc., in numerous installations in the heat treating field, chemical industries, food processes, power plants, and similar productive industries. Electrical data and wiring diagrams, together with descriptions and dimensions of commonly mounted valves complete useful information covering this line. Automatic Temperature Control Co.

9 **Electrical Equipment** — Booklet B-3223 lists special qualities of Hipersil Cores—smaller sizes, lighter weight, wider range of linear response and simplified construction. Also contains charts of application, performance curves and tables showing complete range of core sizes available. Westinghouse Electric & Mfg. Co.

10 **Metal-Clad Switchgear** — Operating principles and six of the many standard applications of MI-9 metal-clad switchgear are described in new bulletin GEA-4059. This moderate capacity switchgear is shipped assembled, ready to install. General Electric Co.

11 **Electrode Index** — A new electrode comparison chart helps to simplify buying of welding electrodes. The chart details the principal AWS and ASTM electrode classifications and indicates which electrodes produced by 20 leading manufacturers meet the different requirements. Air Reduction Co.

12 **Electrical Insulation**—Bulletin 143 entitled "Thermobonds, the New Insulation," describes ten insulating mediums that have been thoroughly tested in the applications for which they have been produced by subjecting them to excessive heat, heavy overloads, and atmospheres crowded with acid or alkali fumes and abrasive materials. Thermobonds are used for such units as high speed armatures, high cycle drill and grinder motors, heavy duty motors and transformers, and marine engine magneto coils. The Sterling Varnish Co.

13 **Welder's Vest Pocket Guide**—Valuable vest pocket guide pictures and explains what is wrong with different types of faulty welds, and how to correct these faults. Illustrates all kinds of joints, fillet welds, and how to cut electrode waste. Explains the 3 essentials of proper welding procedure; illustrates welding symbols; contains trouble check chart on welding machine troubles; a how-to-find list and handy reference information on decimal equivalents. The Hobart Brothers Co.

HEATING AND AIR CONDITIONING

14 **Unit Heaters** — Circular describes Carrier's Five-Way vertical discharge heater and horizontal discharge-unit heater. Tells unit heater construction, assembly and installation. Carrier Corp.

15 **Centrifugal Blowers and Exhausters**—Construction features and operating characteristics of Roots-Connersville centrifugal blowers and exhausters are described in new Bulletin No. 120-B-12. These blowers are widely used in supplying air for agitation of liquids, oil and gas burners, supercharging and scavenging Diesel engines, air conditioning systems, etc. Roots-Connersville Corp.

16 **Humidification Data** — "Armstrong Humidifiers in Industry," a new bulletin describes the application of humidification in a wide variety of industries and the benefits it provides. Among industries mentioned are textile, woodworking, chemical, food, explosives, printing, paper, leather, rubber. Data is also included on the use of humidification for the control of dust, lint, and static electricity, and for increasing human comfort and efficiency. Armstrong Machine Works.

17 **Oil Heaters**—Bulletin 1641 "G-Fin Storage Tank Oil Heater," explains construction of the G-Fin elements, graphically shows heater design, and explains different arrangements in which the heater is furnished, and tables of dimensions and ratings. Griscom-Russell Co.

INSTRUMENTS AND CONTROLS

18 **Hydraulic Control**—Bulletin 78-D tells about the Sperry Extractor hydraulic control for operation of industrial, marine and aircraft equipment. This single tube remote control system, capacity up to 400 in. lb, is said to give motion through 55 deg without time lag of backlash. Sperry Products, Inc.

19 **Insulation Resistance Tester**—Attractively illustrated 12-pg Bulletin No. 1735 describes the new "Megger" insulation resistance tester. Pictures operating details; gives specifications; lists literature dealing with how and why of "Megger" testing. James G. Biddle Co.

20 **Combustion Control Systems**—How combustion control systems can help power engineers improve plant performance from standpoint of continuity of operation, steaming capacity, fuel economy and safety is outlined in illustrated Bulletin No. 15-B. Bailey Meter Co.

21 **Instrument Publication** — "Electric Instruments, Principles of Operation," presents a concise discussion of the characteristics of instruments, what makes them operate, and the individual limitations of the various types. Designated GET-1173, the publication points out that the use of electricity in manufacturing processes has become so general that the important question of whether it is being used in the most economical way is sometimes overlooked. Electric instruments are defined simply as the tools for obtaining essential information about electric circuits. General Electric Co.

List Items You Want On Handy Coupon On Following Page

22 **Combustion Meters** — Bulletin No. 39-297—16-pg treatise "Measuring Combustion"—gives the principles of combustion and its measurement in terms of CO_2. Illustrates several types of combustion meters, giving principle of operation. The Hays Corp.

23 **Handy CO_2 Analyzer**—Bulletin 338 describes simplified Firite "Orsat" analyzer. Held in hand while you make tests. A complete analysis in 40 seconds. Also tells about Fire Efficiency Finder—a calculator that converts CO_2 and stack temperature readings into heating efficiency percentages. Bacharach Industrial Instrument Co.

MECHANICAL TRANSMISSION

24 **Bearing Handbook** — Why bearings are used—the function of each type of bearing—how loads are transmitted—all the why's and wherefore's of bearing designs and uses; these and every other fact needed for understanding of anti-friction bearings are set forth in a new 32-pg book entitled "Facts about Anti-Friction Bearings." Contains 75 diagrams, 41 phantom drawings and photographs, bearing descriptions in simple, easy-to-grasp language. Ahlberg Bearing Co.

25 **Belting** — 20-pg booklet "Leather Belting Conservation and Other Engineering Data," describes the proper selection, correct installation and maintenance of leather belts, methods for aligning shafting and pulleys, cleaning and dressing oak-tanned flat leather belting, belt speeds and recommended pulley diameter tables, belting formulas and specifications. Baldwin Belting & Leather Co.

26 **Handbook on V-Belts**—16-pg pocket-size handbook entitled, "Plain Facts on Wartime Care of Rubber V-Belts," applies to all makes of V-belts and explains ways V-belt construction affects its maintenance, what determines life expectancy of a set of V-belts and what to do about worn sheaves. Allis-Chalmers Mfg. Co., Texrope Div.

27 **Power Transmission Program**—The necessity for and the know-how of a planned wartime power transmission program is discussed in 32-pg manual. Packed with helpful operating and maintenance hints on belting, pulleys, shafting, bearings, etc. Cling Surface Co.

PIPING VALVES AND FITTINGS

28 **Pipe Expansion Calculator**—Simple, time-saving slide rule shows expansion in 100 ft of pipe—for various materials and temperature ranges. Abbreviated steam table printed on face of calculator. Easy to work; no chance of errors. American District Steam Co.

29 **Portable Pipe Bender**—How to bend steel pipe in one simple operation is outlined in bulletin on Tal's Prestal hydraulic portable pipe bender. Saves fittings, elbows, etc., reduces friction losses by producing smooth bends. Tal's Prestal Bender, Inc.

30 **Piping Insulation**—4-pg briefalogue, just off the press, contains a general description of the entire line of Ric-wiL products for the insulation and protection of steam, hot water, oil and process liquid distribution piping. Many interesting installation photos. The Ric-wiL Co.

31 **Steam Trap Guide**—"How to Choose a Steam Trap" is the title of a new informative steam drainage guide, 40 pg of condensation rate charts, graphs, tables—formulas for computing condensing capacity of steam using equipment—trap sizes for unit heaters, header drips, jacketed kettles, etc. The V. D. Anderson Co.

32 **3-Point Pipe Gage** — Folder describes operating features of new pocket size three-point pipe gage for instantaneous measurement of all sizes of pipe from ⅛ in. to 12 in. Gage gives drill size for tapping; eliminates guesswork and errors. Three-Point Gage Co.

33 **Piping Maintenance**—Six-pg folder entitled "Short Cuts to Faster Piping Jobs" provides helps in meeting piping material shortages, and describes and illustrates a few examples of wartime piping ingenuity. One section tells how to get piping jobs done in the face of material shortages. Bulletin presents a few hints on using alternate materials, and on wartime installation practices. Crane Co.

34 **Steam Trap Tips**—Catalog 66 explains features of Strong steam traps. Also provides important trap facts, selector chart, steam table, installation tips of value to engineers and maintenance men. Strong, Carlisle & Hammond Co.

PRIME MOVERS AND EQUIPMENT

35 **Turbines**—20-pg catalog, No. GEA-1145D, covers Type D mechanical-drive turbines with photographs and diagrams illustrating construction features and general specifications. Also furnishes dimensions and typical installation photographs. General Electric Co.

36 **Diesel Engines** — New publication entitled "Fairbanks-Morse Diesels for Profitable Power," gives particulars on design, manufacture and service facilities applicable to the entire commercial line of marine and stationary Fairbanks-Morse Diesels. Included is a loose leaf supplement sheet giving detailed operating cost data for typical Fairbanks-Morse municipal plants. Fairbanks, Morse & Co.

37 **Gas Engines**—Vertical 4-Cycle totally enclosed Type CCG gas engines are illustrated and described in Bulletin S-550-B21. Contains photographs of installations, cross-sectional drawings, tables of dimensions. Worthington Pump & Machinery Corp.

38 **Turbines, Engines and Boilers**—Bulletins describe a complete line of turbines, engines and boilers and includes specifications and dimensional data on types to meet all requirements. Murray Iron Works.

39 **Diesel Electric Maintenance**—New Victory Maintenance Plan folder provides practical and convenient check-charts for Diesel electric plants. These forms and operating hints should help your men detect and avoid trouble—prevent outage and loss of output. Westinghouse Electric & Mfg. Co.

40 **Surface Condensers**—36-pg bulletin with 70 illustrations, including cross-sectional views, discusses structure and design features, steam penetration, air removal equipment, marine condensers, etc. Ingersoll-Rand Co.

40A **Diesel Turbochargers** — Applications of the Elliott-Buchi System of turbocharging to both air and solid injection Diesel engines, as well as to low-, medium-, and high-speed engines, are covered in new 16-pg Bulletin M-5. Cutaway views in color illustrate features of turbine, blower, air inlet silencer and the water-cooled, self-contained lubricating system of the unit. Elliott Co.

WATER TREATMENT

41 **Feedwater Treatment**—4-pg folder introduces Tanalginate, new protective and reactive colloidal material for conditioning boiler feedwater. Product is used in conjunction with such inorganic chemicals as phosphates or alkali. The Bird-Archer Co.

42 **Acid-Regenerated Zeolites**—Report No. 27 discusses data on characteristics of the newly developed acid-regenerated zeolites generally known as the carbonaceous zeolites. The paper covers a series of tests giving much research data and also formulates a means by which the results can be predicted from the accurate analysis of the raw water supply. Cochrane Corp.

43 **Automatic Proportioning Equipment** —Bulletin No. 1700 describes the complete line of %Proportioneers% constant rate and flow responsive proportioning equipment. Contains flow diagrams showing latest applications for the process industries. Among operations diagrammed are: Treating water, food products, oils and boiler water; Blending ingredients in the production of plastics, synthetic rubber, lubricating oils and aviation gasolines; Diluting caustic or other concentrate. %Proportioneers, Inc.%

44 **Boiler Water Conditioning** — 15-pg bulletin No. 504 covers boiler water conditioning; explains types of impurities in boiler feedwater and how they accumulate; causes of boiler scale, sludge, corrosion and carryover. Describes Elgin Deconcentrator. Elgin Softener Corp.

MISCELLANEOUS

45 **Fast Way Shipping**—"How To Ship by Air Express During Wartime" is the title of an indexed handbook in file form on the who-what-where-when-and-how of fast shipping of motors, valves, machine tools and other vital equipment. Railway Express Agency, Inc.

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46 Gunite Applications — Illustrated bulletin shows how Gunite concrete is being used for building and repairing ash bins, coal bunkers, stacks, steel tanks, tunnels and other structures. Pressure Concrete Co.

47 Coating for Corrosive Conditions—12-pg data bulletin summarizes the unusual properties of Ucilon, a new surface coating material that stands up under many of industry's most corrosive conditions. Resistant to organic and inorganic acids, alkalies, salts, alcohol, gasoline, oils, greases and moisture; it also has excellent dielectric strength and can be readily applied to wood, metal, concrete and other surfaces by brushing, spraying or dipping. United Chromium, Inc.

48 De-Scaling Data—Concisely edited for busy power plant superintendents and engineers, newly revised 20-pg cleaning manual describes safe, fast, low cost methods of de-scaling transformers, Diesel water jacket coolers, surface condensers, etc. Oakite Products Co.

49 Oil Purifiers—New bulletin covers YM Oil Reclaimers with capacities ranging from 2½ gallons in 70 to 90 minutes to 120 gallons in the same length of time. These reclaimers are recommended for restoring all types of used oils, including oils drained from aircraft engines, Diesel locomotives, marine stationary Diesel engines, hydraulic machines, gear reducers, compressors, portable Diesels, gasoline engines, gas engines, ice machines, vacuum pumps, and similar installations. Youngstown-Miller Co.

50 Material Handling Equipment—New 64-pg Catalog No. 435 describes capacity, operating features and applications of Syntron electric vibrators for bins, hoppers, and chutes; "Vibra-Flow" vibrating feeders, dry chemical feeder machines, "Weigh-Flow" gravimetric feeder machines, vibratory paper joggers, hydraulic vibrators, feeders and feeder machines, replacement shaft seals, concrete vibrators, etc. Syntron Co.

51 Packings—A comprehensive line of packings, gaskets, gasket and lubricating pastes, oil seals, etc., is described in a 64-pg illustrated catalog. Text and tables of recommendation facilitate selection of satisfactory material for any packing job. The Garlock Packing Co.

52 Electric Vibrating Equipment—New Catalog No. 750 with 176 pg covers the complete line of Jeffrey-Traylor electric vibrating equipment for solving many material handling and processing operations in power plants, coal mines, chemical plants and other industries. Photos and diagrams show feeding, conveying, cooling, drying, packing, screening, and many special applications. The Jeffrey Manufacturing Co.

53 Open Steel Flooring — Open steel flooring, gratings, and safety steps are described in a 24-pg catalog, entitled "Industry's Magic Carpet." Installation views show the applications such as armored flooring, power house floors, marine engine room floors and safety steps, etc. A standard safe load table and complete dimensions will assist engineers in laying out flooring for individual requirements. Kerlow Steel Flooring Co.

54 Quick Floor Repairs—Folder "Floor Patch" describes a product that repairs floors immediately and allows you to open the spot to regular traffic immediately. Floor patch is solid and permanent. This new plastic bonds tight to old concrete and withstands extreme loads. Flexrock Co.

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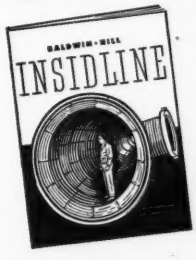

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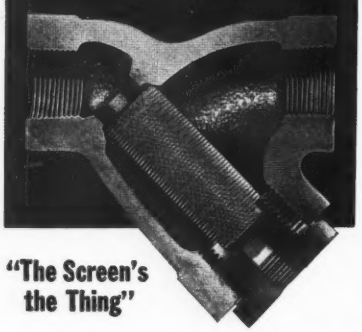

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referred to in these columns, and work on building erection will be placed under way at early date. New unit will form an extension to present Station "B" on Concepcion Road, comprising a multi-story structure that will provide for expansion both in steam and electric divisions. Contracts for primary have been awarded, and it is expected that installation of a high-pressure boiler unit will be placed under way by close of this year. A 30,000-kw turbine-generator is scheduled for delivery next July. Awards for auxiliary equipment are scheduled to be made at early date and as the project progresses. Entire project is estimated to cost about $2,000,000. As previously mentioned in these columns, the expansion has been authorized by WPB, with completion expected late in 1944.

Water Project at Baltimore To Cost $5,000,000

BUREAU OF WATER SUPPLY, Baltimore, Md., has plans maturing for a large waterworks development for increased municipal water supply. A new source will be developed on Patapsco River, where a large pumping plant will be constructed, with motor-driven pumping machinery and auxiliary equipment to provide for output of about 40,000,000 gal per day. Plans for this station are now being prepared, as well as for other features of work, including tunnels, pipe lines and other facilities. Entire program will cost approximately $5,000,000 and is estimated to require about 16 months for completion. It is expected to secure a priority rating for project.

A.S.H.V.E. to Hold 50th Annual Meeting

THE 50TH ANNUAL MEETING of the American Society of Heating and Ventilating Engineers will be held at the Hotel Pennsylvania, New York, N. Y., January 31, February 1 and 2, 1944. To properly commemorate the 50th Anniversary of the organization of the Society the New York Chapter is developing a special program which will be appropriate for the occasion. A three-day session will be held and technical papers of basic importance will be presented.

Draftsmen for War Work

THE U. S. CIVIL SERVICE COMMISSION is seeking over a hundred draftsmen for work in Federal agencies that is necessary to the prosecution of the war. Entrance salaries range from $1752 to $3163 a year.

Draftsmen of all types are needed, particularly ship, electrical, and mechanical draftsmen, as well as topographic draftsmen. Qualified engineering draftsmen in any field are urged to apply. However, persons without previous experience in the fields where needs exist may be appointed and trained in the subject. Women are especially desired. Applicants having training or experience primarily in commercial art, interior decorating, etc., which included any drafting training or experience will be considered.

Interested persons may secure Announcement 283 and application forms from first- and second-class post offices; from Civil Service regional offices in regional headquarters' cities; or from the U. S. Civil Service Commission. Applications should be sent to the U. S. Civil Service Commission, Washington 25, D. C.

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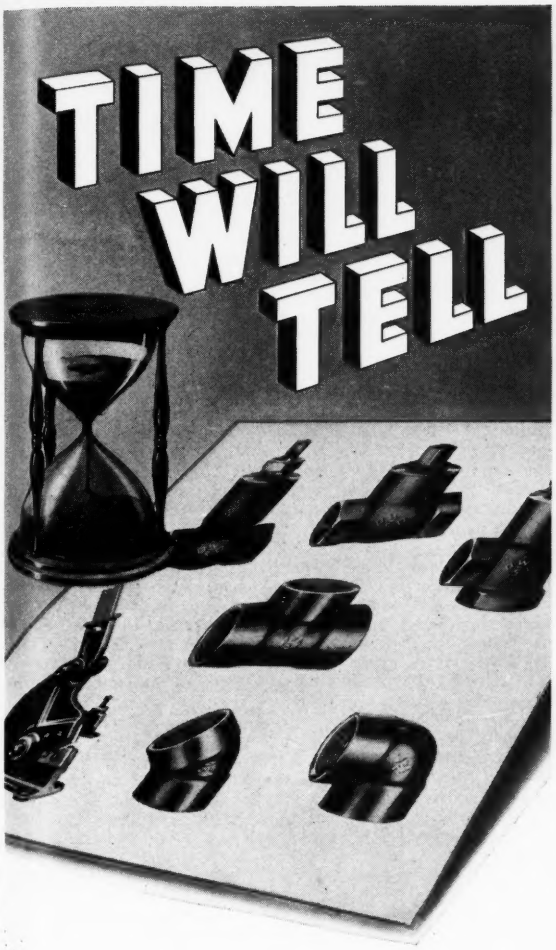

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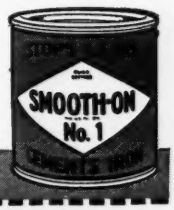

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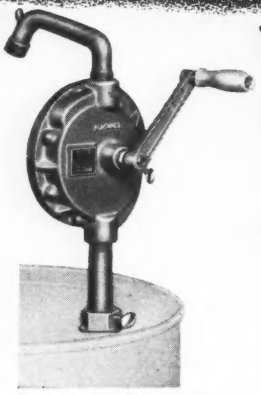

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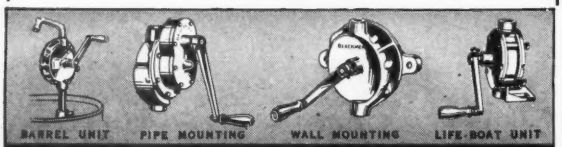

BLACKMER Rotary PUMPS
"BUCKET DESIGN"—SELF-ADJUSTING FOR WEAR

NEW ENGINEERING BOOKS

Nitriding Furnaces. By D. Landau; 1943. First edition. 6 by 9 in.; 100 pages; paper bound. Published by the Nitralloy Corp., 230 Park Ave., New York City. Free upon request to publisher.

For the purpose of giving the reader a few approximate figures which he may need in a tentative study, the author, industrial applications engineer for the Nitralloy Corp., has prepared this book from a compilation of data which have been collected and digested. Nitriding steels were invented in 1926 and are marketed under the trade name of Nitralloy and it is to the treatment of these steels that this book is devoted. The process of case hardening steels of this type consists of subjecting these alloys to the action of anhydrous ammonia gas at temperatures within the range of 930 to 1000 F and under a low pressure of a few inches of water. The time required varies with the temperature and the thickness of the case desired, somewhere between 12 and 90 hr. After classifying the types of nitriding furnaces into continuous, semi-continuous and batch type, the author describes in detail the features of the various commercially available furnaces, their operation and control methods. The handling of the ammonia, the determination of the furnace size, and the instruments used are each given special sections in the book. This practical treatise on the subject of nitriding furnaces should be helpful to engineers interested in case hardening.

Proceedings of the Third Annual Water Conference. 8½ by 11 in., 123 pp, paper bound. Published, 1943, by Engineers Society of Western Pennsylvania, Civil Engineering Section, William Penn Hotel, Pittsburgh, Pa. Price $3.00.

In the foreword to these proceedings, prepared by H. M. Olson, chairman of the conference, it is stated that these printed proceedings of the 1942 Water Conference are the second such printing of papers read and discussed at the Society's Water Conferences. The papers printed in this volume are those presented at the Third Annual Conference held in Pittsburgh on November 9 and 10, 1942, and deal with subjects uppermost in the minds of engineers who have problems of water treatment for all kinds of uses. The authors, for the most part, are specialists in water treatment and are associated with manufacturing and consulting engineering companies. Their interests cover the entire field of water treatment. The papers presented and discussed in these proceedings are: The Use of Inhibitors for Aluminum Chemical Equipment; Recent Developments in Underwater Paints and Coatings; Solubility of Salts in Steam at High Pressures; Protection Against Caustic Embrittlement by Coordinated Phosphate pH Control; Slime Control in Cooling Equipment with Phenol Derivatives; The Effect of Water Conditioning on Condensers, Pumps and Heat Exchangers; The Use and Application of the Dorrco Hydro-Treater; Water Treating Equipment for War Industries; Some Applications of the Organic Ion Exchangers. All these papers are of the informative type and presented in a way to help water users to solve the problems discussed. The proceedings are a distinct contribution to the literature of applied science.

Economic Mineral Deposits. By Alan M. Bateman. Size 6 by 9 in.; 898 pp; illustrated; cloth bound. Published, 1943, by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price $6.50.

"Few people realize during times of peace," says the author of this book, "the extent to which nations have become dependent upon minerals. They are the backbone of modern industrial life. Wartime brings the forcible realization that ships, planes, tanks and guns are not only made of minerals but are propelled by them. The far corners of the earth are searched and developed to produce a continuous flow of war minerals. This book is about mineral deposits, how they are found, how and where they occur, and what they are."

The book is divided into three parts: I. General Principles and Processes; II. Metallic Mineral Deposits, and III. Nonmetallic Minerals. In Part I, after giving a brief history of the use of minerals and the development of economic geology, the book takes up materials of mineral deposits and their formation; processes of formation of mineral deposits; control of mineral localization; folding and faulting; classifications of deposits.

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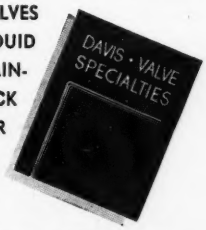

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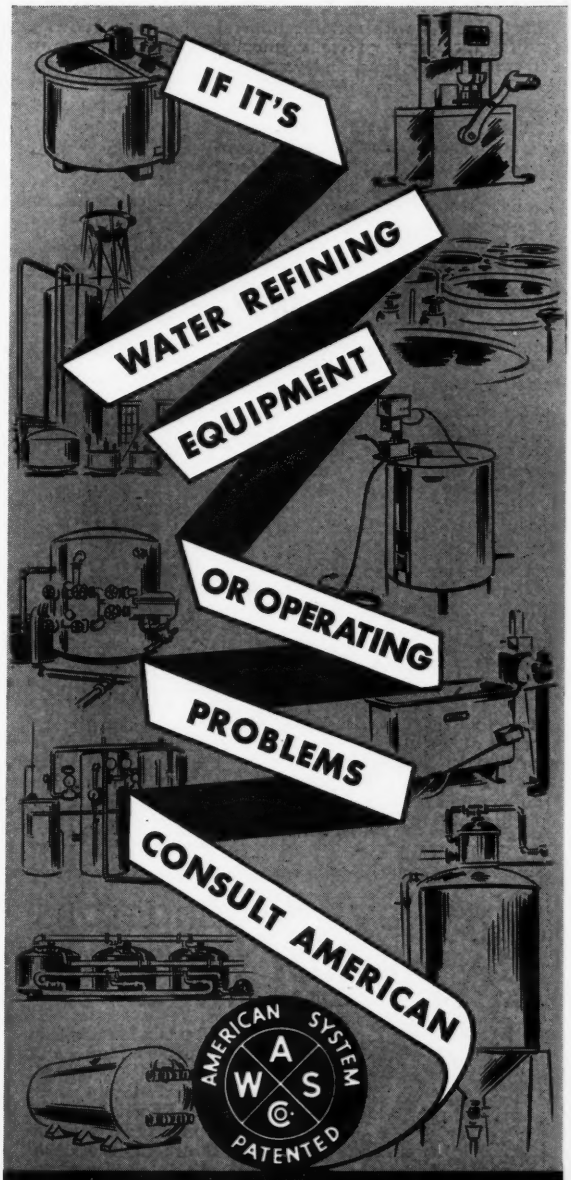

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THE AMERICAN WATER SOFTENER COMPANY
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Part II deals with metallic mineral deposits including precious metals, nonferrous metals, iron and ferroalloy metals and minor metals and related nonmetals.

Part III deals with nonmetallic mineral deposits. The first chapter in this part presents data on the mineral fuels, coal, petroleum and gas. Incidentally, the reader may be somewhat surprised to learn that of the normal world production of coal and lignite, 25 per cent is by Germany and 24 per cent by the United States.

Ceramic materials, metallurgical and refractory materials, industrial, manufacturing, chemical and fertilizer minerals, abrasives and abrasive minerals and gemstones are also discussed.

Turbine Operating Records for the Years 1940-1941; a Report by the Subcommittee of the Prime Movers Committee, Edison Electric Institute; 1943; 8½ by 11 in.; publication No. K-5; 24 pp; paper bound; published by Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price 75 ct.

In line with former reports of turbine outages, this report for the years 1940 and 1941 presents the records of the principal turbines in the utility plants of the country giving their record of performance and the causes for outages. There was an increase of twelve in the number of units reported for 1941 over 1940 with an increase of eight in the number as reporting at a pressure above 1000 psi. The rated capacity increased more than a million kilowatts and the reported generation was up by more than seven million kilowatt hours. The compiled data indicate what has been accomplished by way of increased service hours and corresponding increase of output per unit of capacity to accommodate the wartime demands for more electric energy in the country. This pamphlet should be very helpful in making comparisons between turbines in operation and what should be expected of them.

Aircraft Power Plants. By Arthur P. Fraas. Size 6 by 9 in.; 472 pp; cloth bound. Published, 1943, by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Price $4.50.

To fit the needs of engineering college seniors and of graduate engineers in the armed services or the aircraft industry, Mr. Fraas, Instructor in Aircraft Engines at the Daniel Guggenheim School of Aeronautics, College of Engineering, New York University, has prepared this book, assuming that the reader is familiar with college physics, thermodynamics and fluid mechanics. The book is illustrated with many diagrams and photographs and the method of presentation and the material included have been based on experience gained in teaching courses to U. S. Army and Navy officers, graduate students in aeronautical engineering, and engineers actively engaged in the industry.

The book is divided into three parts. Part I on Engine Operation discusses history and development of aircraft engines, current engines and their construction, basic principles, combustion, supercharging, performance, carburetion, ignition, cooling, vibration, fuels and lubricants, lubrication, oil flow and scavenging, aircraft-engine overhaul and part durability and laboratory testing.

Part II presents the details of engine installation, including general considerations, engine mounts, cowling, liquid-coolant systems, induction, exhaust, fuel and oil systems, accessories and special equipment. Part III discusses propellers and there is an appendix of tables and curves for installation design and testing, and a chapter on laboratory instructions.

ASTM Standards on Copper and Copper Alloys. Size 6 by 9 in.; 385 pp; paper bound. Published, 1943, by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. Price $2.25 for single copies; $1.75 each in orders of ten or more.

Published under the sponsorship of ASTM Committees B-1 on Copper and Copper Alloy Wires for Electrical Conductors, B-2 on Non-Ferrous Metals and Alloys, and B-5 on Copper and Copper Alloys, this book gives in their latest approved form, as of February, 1943, more than 85 ASTM standards on copper and copper alloys, covering cast and wrought material, alloys used for electrical conductors, and nonferrous metals used in copper alloys and provides in convenient form specifications widely used throughout industry and by the Government in connection with the war effort. Important features of the book are the emergency alternate provisions and emergency specifications to aid in expediting procurement.

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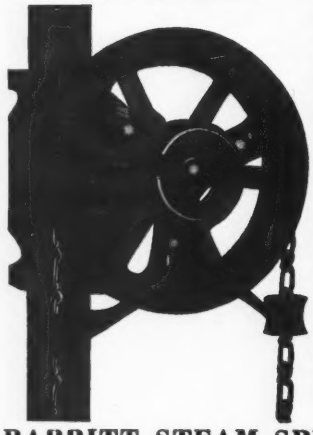

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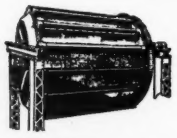

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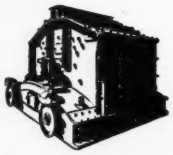

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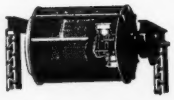

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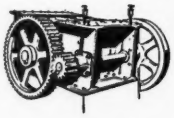

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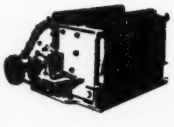

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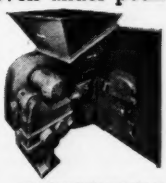

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The book also includes the several widely used specifications on copper-base alloys for sand castings and is completed by standard methods of test including expansion test (pin test), mercurous nitrate test, hardness conversion table and other test procedures.

Heat Transfer Bibliography. Size 6 by 9 in.; 72 pp; paper bound. Published, 1943, as Engineering Experiment Station Series No. 53 by Virginia Polytechnic Institute, Blacksburg, Va. Price 25 ct.

Among the many articles listed in this booklet, the following are of especial interest to the power plant field: Heat Transfer in Natural Convection Evaporators, by G. A. Akin and W. H. McAdams; Heat Transfer in Hot Blast Heaters, by R. W. Angus; Heat Transmission of Insulating Materials; Diphenyl Oxide Bi-Fluid Power Plants; Heat Transmission in Water-Tube Boilers; and Heat Transmission in Boilers. The book concludes with a list of many books that are available on the subject of heat transfer.

The Thermodynamics of Firearms. By Clark S. Robinson. Size 6 by 9 in.; 175 pp; cloth bound. Published, 1943, by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Price $2.50.

A gun is a heat engine, used to convert the heat of exploding powder into mechanical energy. As such it is amenable to the fundamental concepts of thermodynamics. The basic thermodynamics that applies to the explosion in the internal-combustion engine can be applied to the firing of the gun with but few changes and with much profit.

The author has written the book both for use as a text in courses relating to the design of firearms and ammunition and for those who have had no previous training in the subject but may be interested in learning something about it as a matter of general interest because of the war.

It begins with a discussion of basic thermodynamic principles and basic mechanics, continues with a chapter on basic physical chemistry and then discusses heat of explosion and heat capacity of powder gases. This is followed by chapters on ignition of propellent powders, loading density, surface factory recoil, friction, flash and smoke, stability of propellants, measurement of temperature, closed-chamber experiments, and other ballistic calculations. It closes with a chapter on rockets.

Pension and Profit Sharing Plans. Size 8½ by 10., 48 pp, paper bound. Published, 1943, as Analysis 29 by The Research Institute of America, Inc., 292 Madison Ave., New York, N. Y. Price $2.00.

This analysis is one of a continuing series going out from the Institute to its Membership. Deferred compensation plans are not new. But pyramiding personal and corporate taxes, combined with the growing personnel crisis, are creating tremendous interest in this form of trust as a means of holding on to men—both key men and ordinary workers—who threaten to leave for better-paying positions.

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Ordinarily these Analyses reach only the Institute membership. But because of the urgency of the times, the Institute is making Pension and Profit Sharing Plans available to the general public at the price quoted.

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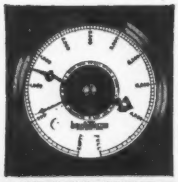

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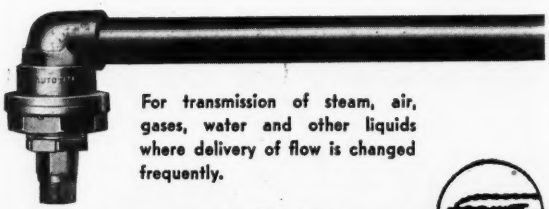

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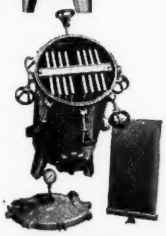

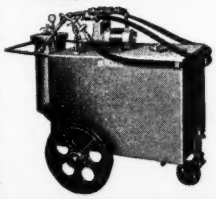

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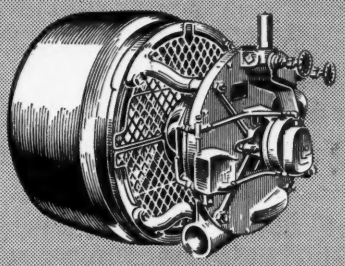

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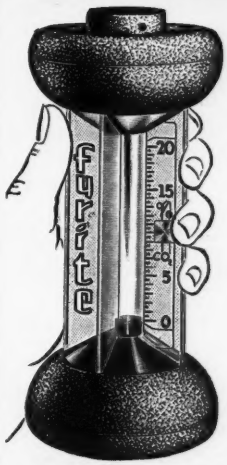

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Power Plant Construction News

Calif., Glendale—Water Department plans new pumping station on San Fernando Rd., where tract of about 2 acres of land is being acquired. Cost estimated about $180,000, with motor-driven pumping machinery and auxiliary equipment.

Fla., Daytona Beach—Federal Works Agency, 20 Fifth St., N.W., Atlanta, Ga., plans construction of two submerged-type pumping stations at Daytona Beach, estimated to cost about $37,000, with pumping machinery and auxiliary equipment. Proposed to begin work soon.

Fla., Keystone Heights—Clay Electric Cooperative Association, Keystone Heights, plans extensions in transmission and distributing lines, totaling about 130 miles, with line transformers, service connections and other operating facilities. Cost about $146,000, with financing through Federal aid. Project has approval of WPB and will be placed under way soon.

Ind., Evansville—Servel, Inc., Evansville, manufacturer of gas-operated refrigerators, etc., now in production for Government, plans installation of electric power equipment in connection with expansion in plant for increased output for war service. Cost estimated about $140,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency.

Ind., Indianapolis — Indianapolis Power & Light Co., 17 North Meridian St., is said to be arranging for expansion in generating station at White River as a post-war project, with installation of additional equipment for increased capacity. Also will make extensions in transmission lines leading from plant, with additional power substation and switching facilities. Entire project is reported to cost about $2,000,000.

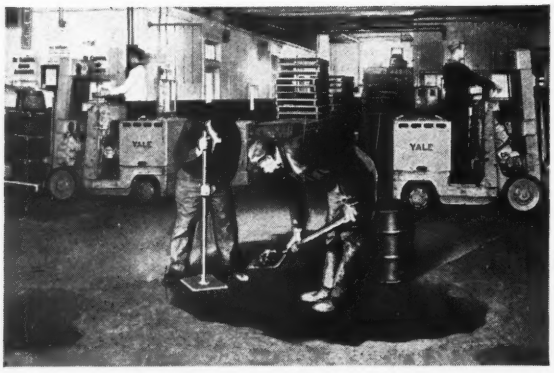
Ind., Lawrenceburg—Schenley Distillers Corp., has approved plans for new addition to power plant at local distillery, to be about 47 x 55 ft, and will install equipment for increased capacity. Cost reported over $200,000, with equipment. Work will be placed under way at once. Carl J. Kiefer is vice-president and engineer, 26 East Sixth St., Cincinnati, Ohio.

Ky., Frankfort—Schenley Distillers Corp., will make extensions and improvements in boiler plant at local George T. Stagg Co., distillery, with installation of additional equipment for increased capacity. Work will be carried out in conjunction with expansion in main plant, now used for production of alcohol for Government, entire project to cost about $550,000. Of this expenditure, approximately $60,000 will be used for boiler house program. Carl J. Kiefer is vice-president and engineer, 26 East Sixth St., Cincinnati, Ohio.

Ky., Louisville—Reynolds Metals Co., 2500 South Third St., has taken over a large plant of Mengel Co., Louisville, manufacturer of wood products, said to represent an investment of more than $1,500,000, and will convert and equip for new works for production of extruded aluminum and magnesium alloy parts for aircraft service for Government, at cost reported over $350,000. Electric power equipment will be installed. Work will be carried out at once.

Minn., Windom—Northwest Flax Industries, Inc., Winona, Minn., John A. Johnson, president, recently organized, will build new flax processing mill at Windom, instead of Winona, as recently noted in these columns. Large tract of land has been acquired. Main mill will be 110 x 130 ft, with several auxiliary smaller structures. A boiler house, 40 x 74 ft, will be built. Erection will begin soon. Entire project will cost about $215,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Boyum, Schubert & Sorensen, 117 West Third St., Winona, are architects.

Neb., Columbus—Anaconda Copper Mining Co., 25 Broadway, New York, N. Y., has contracted with Government for construction and operation of new plant at Columbus for production of extruded aluminum and magnesium alloy parts for aircraft service. It will total about 650,000 sq ft of floor space. Electric power equipment will be installed. Cost reported over $3,500,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency.



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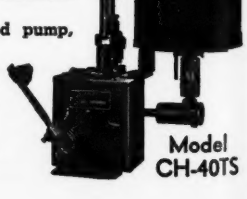

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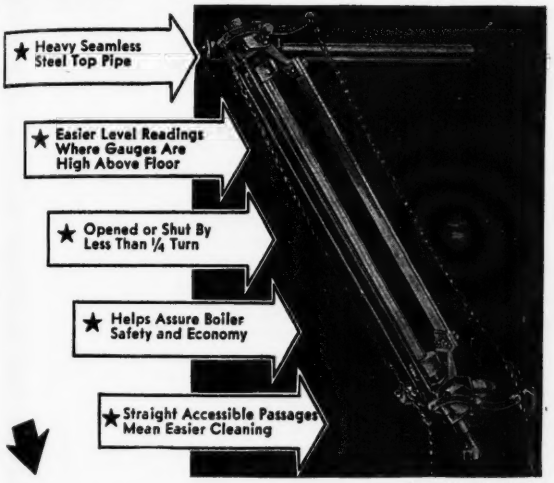
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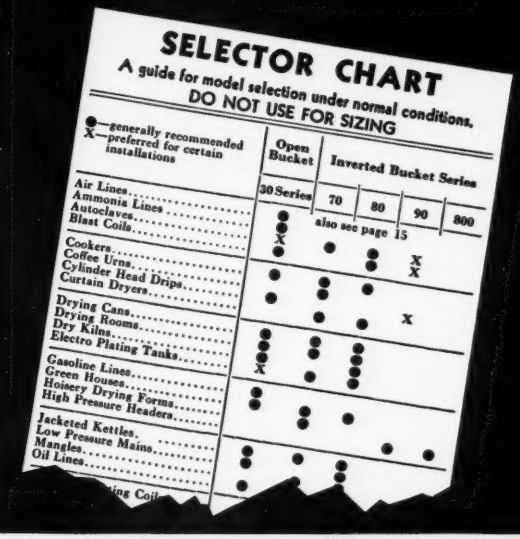

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Company has organized a new subsidiary, Anaconda Alloys Corp., to carry out project. Work will begin soon.

Neb., Lincoln—Lincoln Packing Co., 320 N St., meat packer, plans installation of electric power equipment in new addition to plant, estimated to cost about $200,000, with machinery. Work will be placed under way soon. Henschien, Everds & Crombie, 59 East Van Buren St., Chicago, Ill., are engineers.

N. Y., Farmingdale—Republic Aviation Corp., Conkin St., plans installation of electric power equipment in connection with expansion in aircraft plant for increased production for Government. Cost estimated about $200,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work scheduled to be carried out at once.

N. C., Enka—American Enka Corp., 206 Madison Ave., New York, N. Y., manufacturer of viscose rayon products, plans installation of electric power equipment in new additions to mill for production of high-tenacity rayon yarns, comprising a number of new buildings for large output. Also, will make extensions and improvements in power plant, with installation of equipment for increased capacity. Entire project is reported to cost about $5,000,000, and will have a priority rating. Proposed to begin work at once.

N. D., Minot—Minot Chemical & Carbon Co., plans installation of electric power equipment in connection with expansion in plant for production of lignite coal. Cost about $325,000. Company has arranged financing in that amount through Smaller War Plants Corp., Washington, D. C., Federal agency, and will begin work soon.

Ohio, Painesville—Industrial Rayon Corp., East 98th St. and Walford Ave., Cleveland, Ohio, manufacturer of viscose rayon products, has approved plans for immediate expansion in branch plant at Painesville for production of high-tenacity rayon yarns. Several large buildings will be erected. Electric power equipment will be installed. Cost estimated close to $6,000,000.

Ohio, Rockdale—Sall Mountain Co., Hamilton, Ohio, manufacturer of asbestos paper products, plans installation of electric power equipment in connection with proposed rebuilding of mill at Rockdale, near Hamilton, recently destroyed by fire, with loss reported over $150,000, including machinery.

Pa., Pittsburgh — Carnegie-Illinois Steel Corp., Carnegie Building, Pittsburgh, plans installation of electric power equipment in connection with expansion in mills in Pennsylvania, Indiana and Illinois. New buildings will be erected and machinery installed for considerable increased output for Government. Entire project will cost about $1,500,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency.

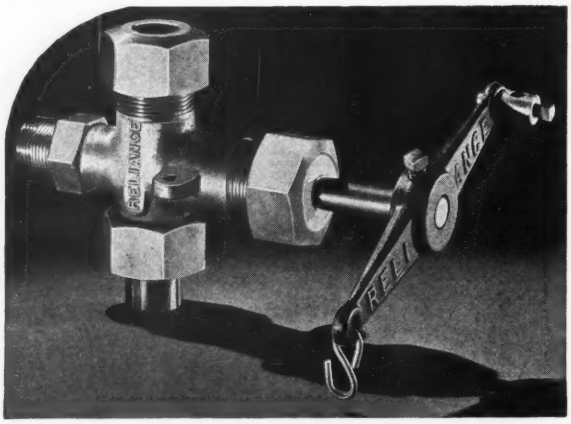
R. I., Warwick—Apponaug Co., 65 Centreville Rd., has plans for addition to boiler house at textile print works, with installation of equipment for increased capacity. Work will begin soon. No estimate of cost announced.

S. D., Sioux Falls—Sioux Falls Rendering Co., plans installation of electric power equipment in proposed new soy bean processing mill. Company has taken over former local feed mill of Batchellor Milling Co., and will remodel and equip for plant.

Tenn., Memphis—Reynolds Metals Co., 2500 South Third St., Louisville, Ky., plans power house at new plant at Raines Station, near Memphis, for production of extruded aluminum and magnesium alloy parts for aircraft service for Government. Plant will be located on a 270-acre tract of land and will comprise a large group of one and multi-story buildings. Entire project will cost about $18,000,000, with financing to be provided by Defense Plant Corp., Washington, D. C., Federal agency.

Texas, Houston — Water Department plans installation of motor-driven pumping machinery and auxiliary equipment in connection with drilling of four new water wells at water source, west of city, to increase present output by 2,000,000 gal per day. Also will install water purification plant and other water works equipment. Entire project will cost about $5,300,000, of which it is proposed to secure Federal aid in amount of $2,300,000.

Wash., Seattle—Frye & Co., 2203 Airport Way, meat packers, plan installation of electric power equipment in new four-story meat-packing plant, to replace building destroyed by fire several months ago. Cost reported over $175,000, with machinery. Proposed to begin work soon. Henschien, Everds & Crombie, 59 East Van Buren St., Chicago, Ill., are engineers.



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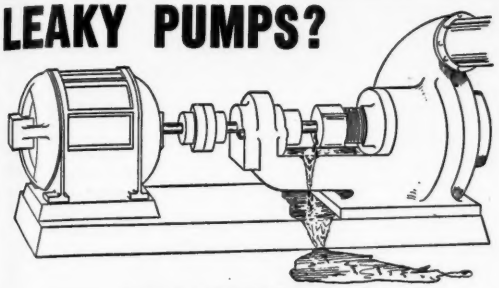

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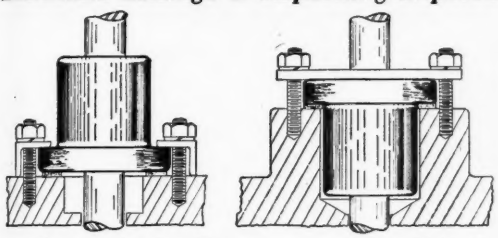

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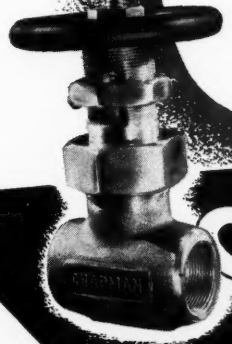

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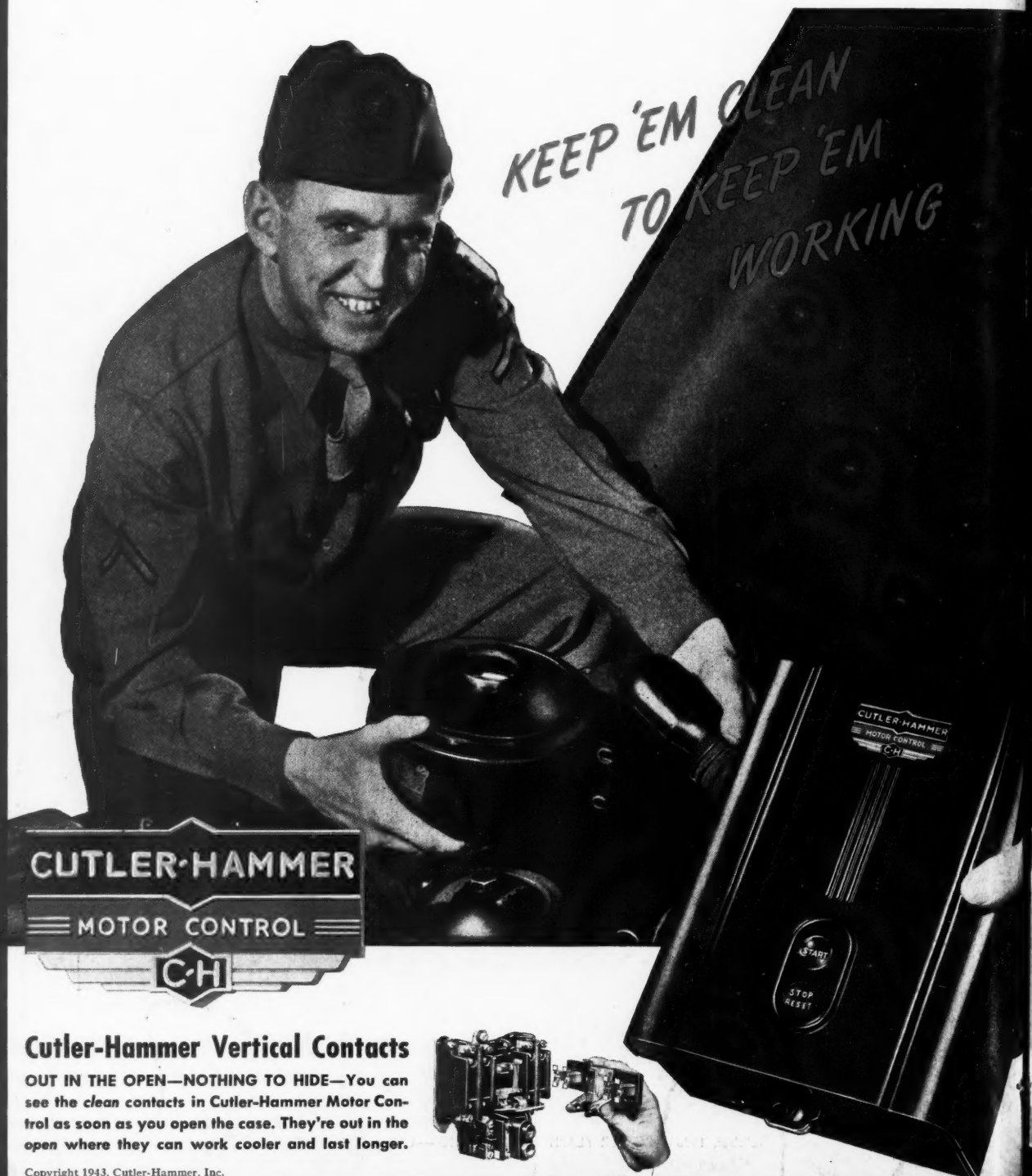

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